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DEVELOPMENT AND EVALUATION OF A GROUP SUPPORT SYSTEM IN ORGANISATIONAL SETTINGS

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A submission presented in partial fulfilment of the requirements of the University of Glamorgan/Prifysgol Morgannwg for the Degree of Doctor of Philosophy by Portfolio

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Declaration

This thesis is based on research work conducted by myself, and by myself in conjunction with others. My contribution to the overview and each of projects contained within this portfolio is as follows:

Overview

My personal contribution has included the extension of the Research Framework for GSS Evaluation, and the application of this framework in two organisation settings (Projects Two and Three). I am also solely responsible for the writing of this overview, including the introduction, literature review, methodology, discussions of each of the projects and the portfolio, and the conclusions and future research.

Project One

Development and applications of a Group Support System. My contribution has included the development and applications of the GSS in organisational settings, and the development and extension of the GSS Design Framework and GSS Design Guidelines. I was solely responsible for all software developed as part of the GSS development.

Projects Two and Three

My personal contribution to these projects has included software design and development, implementation of a GSS in organisational settings, analyses of the data obtained through these applications, and conclusions drawn from these analyses.

A handwritten signature in black ink, reading "Martin J. Read". The signature is written in a cursive style with a horizontal line underneath.

(M J READ)

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I would like to thank my supervisor, Professor Tony Gear, for his encouragement, guidance and support, and for his attention to detail throughout many re-readings of the portfolio of work.

I would also like to thank the many staff in different organisations that have co-operated with me. In particular I would like to thank Rune Devold and Per Meland of TeamStandards for welcoming me into their organisation and giving me access to such a large amount of information.

Last but not least I would like to acknowledge the support and patience of my wife and children without whose tolerance I could never have completed this portfolio.

ABSTRACT

Group Support Systems (GSS) are systems, normally involving the use of Information Technology, that have been designed to support groups of people meeting to undertake some task. By providing an additional channel of communication, GSS attempt to reduce group process losses, such as domination of the group by one or more members, and to enhance positive aspects of the group process, for example a group member thinking of a new and useful idea as a result of awareness of the contribution of other group members.

A number of different types of GSS have been developed involving different levels of IT support. However, the majority of research has been targeted at GSS involving networked personal computers, where each member of the group uses an individual personal computer to enter opinions and values. Another type of GSS involves a single personal computer, a large screen that can be viewed by all members of a group, and a number of personal handsets that can be used to send numeric information to the personal computer. Relative to networked personal computer based GSS, there has been far less research on the effectiveness of handset based GSS in supporting a group of people meeting on some task. Additionally, there is conflicting evidence between studies of GSS that have been undertaken in the laboratory, and studies that have been undertaken in the field. Laboratory studies have found little evidence to suggest that the group process is improved through the use of a GSS, whilst field studies have identified benefits. The evaluation of the validity of a GSS is a complex issue, and can be considered from a number of perspectives and approaches.

This portfolio of projects concerns the development and evaluation of a type of k-GSS in organisational settings. The portfolio includes an account of the background to the development of the GSS and an initial evaluation of the usefulness of the system through a number of field studies. Two field applications of the GSS are the subject of an in-depth evaluation, and include evaluation of both process variables and output variables. The evaluation of the GSS in these applications suggests that an important factor in improving the group process through using a GSS is the extent to which dialogue is encouraged in the group. Additionally, a GSS Design Framework and GSS Design Guidelines are identified which should be reviewed when an application using this type of technology in an organisational context is being considered.

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CHAPTER ONE

THE OVERVIEW

1 Introduction

1.1 *PhD by Portfolio Requirements*

The submission for examination of an approved portfolio of material relating to a maximum of three projects accompanied by an overview which demonstrates the originality of the contribution to the field. The projects may be work related and derived from empirical or conceptual investigation. The overview must also demonstrate the relationship between the projects. The submission should demonstrate an independent and original contribution to knowledge at least equivalent to that normally demonstrated by the submission of a thesis (University of Glamorgan Research Degrees and Diploma Regulations, October 2002, p3).

1.2 *Introduction to the Overview*

This portfolio of work, presented in part fulfilment of the requirements of the University of Glamorgan for the degree of Doctor of Philosophy by Portfolio, concerns the development of a Group Support System (GSS) that is known as Teamworker, and the evaluation of this GSS through applications of the system in field situations. The three separate projects presented in this portfolio are:

Project One - The Development and Applications of a Group Support System (GSS). This project includes an account of the development of the Teamworker system, nine examples of the implementation of the system with organisations in various contexts, and an assessment of the value of the system. Two additional applications of the system have resulted in a great deal of data being collected that has enabled analysis of factors that are important in terms of the implementation and effectiveness of GSS. Each of these two specific applications are analysed in Projects Two and Three of this portfolio.

Project Two - Use of a Group Support System in Research Committees. This project is based upon the data collected from peer group Research Committees that form part of a public-sector Research Award Body over a five-year period. The peer group committees were used to rank research proposals from universities and other

establishments to enable funding decisions to be made. Data was collected using Teamworker, and the analysis of this data has enabled an evaluation of the Teamworker GSS to be made in terms of the sensitivity of the rankings produced (and therefore the funding decisions made) on a number of factors. The system has also been evaluated from the perspective of the Award Body officers who sponsored the use of the system in Research Committees.

Project Three - Using a Group Support System to Aid the Development of Professional Judgement. Teamworker has been (and continues to be) used to support groups undergoing professional development and training for the effective implementation of an approach to the gathering and subsequent utilisation of information relating to recipients of nursing, rehabilitation and other care services in Norway and Denmark through the assessment of a number of variables; this approach is known as ‘Gerix’. Participants consider standard cases, for which the ‘correct’ assessments are known, but not by the members of the groups. The availability of this data allows some measurement of the efficacy of this approach to professional judgement development. This third project is based upon the data collected at these professional judgement development sessions and subsequent analyses of this data. The system has also been evaluated from the perspective of the Gerix project managers and group participants.

The field applications analysed in Projects Two and Three are not necessarily representative of all possible field applications, but they are situations where access has been obtained, and where:

- A great deal of data has been collected over a long period of time.
- The data collected is repetitive, in that the same process has been replicated many times.
- The context for each of these applications can be well defined.
- The fact that the Teamworker GSS has been used for many meetings over a long period of time means that user satisfaction is likely to be high. However, the data collected gives opportunities for other issues of GSS evaluation to be considered.

Each of these three projects is self-contained in that separate and individual research objectives can be defined for each. However they are related in that each of the projects is concerned with the development and application of a particular design of Group Support System in organisational settings (rather than in the laboratory), and together they add considerably to the knowledge base available on the process of development and application of this type of GSS design. The two projects that evaluate specific applications of Teamworker (Projects Two and Three) each address research questions specific to the context of each of these applications. The analysis of these research questions with respect to the context of the applications has enabled the theory of GSS to be extended with respect to the evaluation of GSS, i.e. within a specific context what effects can be identified on the group process and outcomes?

Much of the development of the Teamworker Group Support System has involved collaboration with others, notably with Professor Tony Gear, who has co-authored with myself many of the academic papers that have resulted from the work discussed in this portfolio. Additionally, the development and applications of the GSS have involved an action research approach, involving employees within the organisations that have applied the GSS. My personal involvement has included the design and development of software, the design of hardware, the design of process models that make use of the Teamworker system in organisational contexts, the application of Teamworker within organisations, and the analysis of the outputs of group sessions involving Teamworker. The writings within this portfolio are my own work, although inevitably reference is made to previous work both of myself and of others.

1.3 Background to the Research

For some time, it has been recognised that managers spend a great deal of their time in meetings. Meetings are held to discuss issues, make decisions and plan actions. A number of advantages can be identified for people to meet together in groups; for example it is perceived that a group of people may be better at making a complex decision than a single person, and that the people who may need to put plans into action should be involved in the decision making process (e.g. Michaelson *et al*, 1989; Jennings and Wattam, 1994). However, there are problems that can be identified in meetings, which are known as group process losses (e.g. Nunamaker *et al*, 1991;

Brown, 2002). These process losses can include the effects of one or two members of a group dominating the meeting, or meeting participants simply conforming to a majority view without ensuring that a full range of options are considered.

Group Support Systems (GSS) are a type of information system, normally making use of information technology, which have been designed to support groups of people meeting together. Group Support Systems have traditionally been designed to support the decision making or problem solving group, and the term often used when a GSS is applied in this way is Group Decision Support System (GDSS); see for example DeSanctis and Gallupe (1987). However, their use has been broadened to support groups working on a variety of tasks, not just a decision-making or problem solving task. The broad term of Group Support Systems (GSS) is now often used to label systems that support a group meeting to work on some task (e.g. Briggs *et al*, 1998b), however other terms are also used, including Electronic Meeting System (EMS), Group Communication Support System (GCSS), and Group Process Support System (GPSS). The Teamworker GSS that I have developed and applied in various organisations has been variously known as a Group Decision Support System, Group Process Support System and Group Support System. For consistency, I will continue to use the term Group Support System (GSS) when discussing Teamworker and other similar systems in this portfolio, except when other authors or researchers specifically use a different term in relation to their own writings and research.

Group Support Systems are a type of information system that supports the group process through facilitating enhanced communication within a group. Substantial research has now been completed on the use of GSS, often through the use of experimental laboratory research, but also through field studies (e.g. Chun and Park, 1998), and this work is reviewed in the Literature Review Chapter of this portfolio. However, despite the fact that there is more than one design of GSS, the majority of research has been directed at a particular form of GSS, principally GSS that make use of networked personal computers within what is termed a 'decision room' (e.g. Pervan, 1998). For a number of years I have been involved in developing the Teamworker GSS that is based upon radio handset technology (rather than networked personal computer technology) and applying this GSS into organisations. Managers and other organisational personnel in more than twenty different organisational contexts have now

used this GSS. There appears to be limited written evidence of the efficacy of systems such as Teamworker in the academic community, therefore this portfolio of work is a unique contribution to the knowledge base on this type of GSS, albeit specifically concerned with the Teamworker system.

1.4 Aims of the Portfolio

The aims of the research identified in this portfolio are:

1. To develop a new type of handset based Group Support System (GSS), known as Teamworker, aimed at supporting groups of people. The design aim of the system is to reduce group process losses and enhance group process gains (e.g. Nunamaker *et al*, 1991), and therefore make meetings more effective.
2. To establish a GSS design framework and guidelines that should be reviewed when an application of this type of technology in an organisational context is being considered.
3. To develop a Research Framework for GSS Evaluation that can support the evaluation of GSS in the field.
4. To apply this evaluation framework in two fieldwork contexts where Teamworker GSS has been used.

1.5 Contributions to Knowledge

This portfolio makes the following contributions to knowledge in the field of Group Support Systems:

1. Establishment of a Group Support System Design Framework (see Section 4.4) to guide users of Group Support System applications in terms of the variables that need to be defined when designing a GSS for a particular application.

2. Establishment of a set of Group Support System Design Guidelines (see Section 4.5), based on a variety of field experiments, which should be considered when using a GSS in the field.
3. Establishment of a Research Framework for GSS Evaluation (Section 3.5) to support the evaluation of GSS in organisational contexts, and the application of this framework in two field based situations.
4. Identification of serious concerns with the application of a commonly used group-ranking model involving scoring, averaging and ranking of a set of options (see Section 5.2).
5. Evaluation of the efficacy of this form of low impact GSS technology to enhance social learning by means of dialogue that focuses on differences of opinion in order to promote improvement in professional judgement (see Section 6.2).
6. Identification that a process model, involving the use of a GSS, can give high satisfaction to some important stakeholders but may involve decision quality issues that have not been properly considered and understood (see Section 7). This emphasises the need to consider evaluation of a GSS from each of the three perspectives identified in the Research Framework for GSS Evaluation where possible.

1.6 Structure of the Portfolio

The overview to this portfolio, which demonstrates the originality and contribution to the field of Group Support Systems, is contained within this chapter (Chapter 1). Also contained in this chapter is the literature review and methodology that underpins the research in this portfolio.

Chapter 2 presents Project One, “The Development and Applications of a Group Support System (GSS)”, in detail. This project concerns the development of the Teamworker GSS and discusses nine separate applications in organisational contexts.

Chapter 3 presents Project Two, “Use of a Group Support System in Research Committees”, in detail. This project concerns the application of the Teamworker GSS with a public-sector Research Award Body.

Chapter 4 presents Project Three, “Using a Group Support System to Aid the Development of Professional Judgement”, in detail. This project concerns the application of the Teamworker GSS to support groups learning how to apply the Gerix framework (and the similar ‘Common Language’ framework) for the evaluation of clients in need of social care.

Appendix A (Types of GSS) presents a review of some of the Group Support Systems that are commercially available and currently used in organisations. It is explained how these systems may be categorised, and the differences between each of these systems is established.

Appendix B (Academic Papers) presents a list of the published academic papers on GSS that I have co-authored. My personal involvement has included the design and development of GSS software, the design of hardware, the design of social processes that make use of the Teamworker system in organisational contexts, the application of Teamworker within organisations, the analysis of the outputs of group sessions involving Teamworker, and the writing and editing of the papers together with colleagues.

Appendix C (GSS Teamworker Feedback Screens) presents some of the group feedback screens that I have designed to support group processes in various contexts.

2 Literature Review

This portfolio is concerned with the development and application of a Group Support System (GSS), with particular emphasis on the evaluation of such a system. A GSS can be defined as a computer-based information system designed to support and aid a group meeting at the same time and engaged on some task which is often, although not always, a decision making task. Group Support Systems are also known by many other terms. Traditionally, these types of system have been known as Group Decision Support Systems (GDSS), e.g. Huber (1982), DeSanctis and Gallupe (1987). Other terms that have been used include Group Process Support Systems (GPSS), Electronic Meeting Systems (EMS), Group Communication Support Systems (GCSS), and Computer Mediated Communion (CMC). Many authors include these various terms into the general banner of Group Support System (GSS), e.g. Pervan (1998), Benbazat and Lim (1993), Fjermestad and Hiltz (1998). This general term of Group Support System (GSS) will be used throughout this portfolio.

This Literature Review considers evidence on why Group Support Systems may be necessary to support groups of people involved in making decisions and the effectiveness of these types of system. It begins with a discussion on the distinction between Decision Support Systems and Group Support Systems, and then considers the role of group decision making, the problems that can affect groups, traditional manual methods of supporting groups, how a Group Support System can support a group working on a task such as solving a problem or making a decision, previous research into GSS, and how GSS may be evaluated.

2.1 Decision Support Systems

The research field of Group Support Systems has its background in the Decision Support System literature. There are a number of views about what a Decision Support System (DSS) is and how a DSS can support management decision making, and many authors have attempted to capture the essence of the DSS in a single definition. For example, Sprague and Watson (1996:6) define DSS as “*computer based systems that*

help decision makers confront ill structured problems through direct interaction with data and analysis models.”

Arnold, Cooper and Robertson (1998:302) suggest that most of the major decisions and many lesser decisions made by organisations are not made by individual managers, but rather are the outcome of meetings where groups of people come together to make a decision. As organisational issues become more complex and a greater number of specialists are employed it becomes less and less possible for a single decision maker to be able to make a decision without requiring information from others in the organisation. Even in those situations where a single decision maker has sole responsibility for a decision, it is unlikely that a decision will be taken in isolation from others in the organisation.

It is to support the decision making group that a particular type of DSS has been developed, known as a Group Decision Support System (GDSS) or more recently as simply a Group Support System (GSS). In comparison to traditional DSS, there is less literature available on the development and implementation of GSS; the study of GSS is still at an early stage (Holsapple and Whinston, 1996: 629; Briggs *et al*, 1998b: 4).

Later sections of this Appendix will discuss the problems of groups and how and why they need to be supported by GSS. The next section will consider why groups are important in organisation decision making.

2.2 Group Decision Making

Organisations will often use groups of people to make a decision, rather than relying on a single decision maker. Decision making groups include the Board of Directors, Senior Management Teams, Project Groups, and Review Panels and Committees. The reasons why groups are used in this way by organisations are many, but include the tendency for organisations to increasingly rely on specialists and the increasing complexity of problems where no single individual can understand the complete problem.

Jennings and Wattam (1994: 54) have identified five major reasons why groups are used in decision making. These are:

1. **Legitimacy of Decision.** If a major decision is taken by a single individual, others who are affected by the decision may feel that the decision has been made in an autocratic manner without regard to their interests or opinions. If the decision is made by a group it could be seen as having a general legitimacy even if not all the members of the group agree with the final decision.
2. **Quality of Decision.** This is the ‘many heads are better than one’ argument. It is considered that the wider amount of experience and expertise that many people can bring to a problem will result in a better quality decision. The opposite viewpoint is that ‘too many cooks spoil the broth’. Cherrington (1994: 590) argues that the group decision tends to be superior in certain situations, such as when an organisation is developing a new product as it is virtually impossible for any single individual to comprehend adequately all the areas of knowledge that are required, including legal, marketing, finance and technical knowledge. A problem that might be solved better by an individual is one that involves complex calculations such as developing a inventory-control model, but even in this example groups could be influential, for example in the successful implementation of the model. This issue is further explored in the following section.
3. **Novelty.** A group will often be superior where a problem area requires new ideas or insights. Here techniques such as brainstorming (see Section 2.5.1) will often be successful.
4. **Shortage of Information.** A group will be able to bear more information on a problem area than can be obtained from an individual decision maker. In particular, the group will be able to share and communicate information from each of the group members.
5. **Morale.** Getting more people involved in the decision-making process will improve morale and job satisfaction and will lessen occupational stress and career dissatisfaction.

The above suggests that many if not most organisational decisions should be made by groups rather than by individuals. However there are additional factors that result in many decisions being taken by individuals, including:

1. Decision makers may see a more ‘participative’ approach to decision making as threatening their status and power. This point of view will often be taken by autocratic personalities.
2. Decisions may need to be taken within short timescales where there is not time for a group to meet.
3. A decision may depend on the unique knowledge of a single decision maker.
4. Certain decisions may need to remain confidential and which cannot be divulged to wider audiences.
5. Individuals may be ultimately responsible for making certain decisions and may wish to make these decisions alone. Often, however, these decisions can be supported by advice obtained from a group setting.

This discussion suggests that groups, where they are used to make decisions, should be able to provide better decisions in many situations, although research into this issue is inconclusive.

2.3 Will Groups Outperform Individuals?

A number of studies have been undertaken to identify whether a group can outperform the individual membership of the group. The empirical evidence from laboratory trials relating to the effectiveness of groups in terms of the quality of output decisions is quite varied. For example, many researchers indicate that for interacting groups working on difficult and complex tasks, the collective decision reached does not frequently surpass the pre-meeting view of one or two of the participants. That is, a substantial proportion of interacting groups are outperformed by their most capable member (see for example, Miner, 1984:119; Hill, 1982:535). In contrast, Michaelson *et al* (1989:838) studied individual versus group decision making in 222 project teams engaged in solving contextually relevant and consequential problems. The conclusion reached this time was that groups outperformed their most proficient member on 97% of occasions.

Furthermore, Reagan-Cirincione (1994) has reported the results of an empirical investigation in which 13 out of 16 interacting groups outperformed their most capable individual member. In conclusion, she stated that:

Small interacting groups were able to perform significantly better than their most proficient members on decomposed judgement tasks when aided by an enhanced, iterative 'estimate-feedback-talk' process

(Reagan-Cirincione, 1994:267).

Watson *et al* (1991a: 808), in a longitudinal study, found that best members became less important to group success as the groups' experience in problem solving increased and that there is great value on group-consensus decision-making. Steiner (1972:9) has identified the problem of 'group deficit', that is that the actual productivity of groups will fall below the potential group productivity because of faults in the group process, also known as 'process loss'. These process losses arise from problems that groups have, including problems that groups have in coordinating their activities (i.e. people cannot all speak at once) or that arise from social influence processes within the group, e.g. social loafing. Other studies that address group decision-making have identified a number of factors that will affect the group process and outcomes, including polarisation and groupthink (Brown, 2002:222). Social influences will also affect the effectiveness of the group, including the effects of conformity and the influence of minorities (Brown 2002:165). These group issues are addressed in the following section.

2.4 Problems of Groups

There are a number of advantages to groups being involved in making a decision rather than a single decision maker, and many organisational decisions are made using group processes. There are, however, a number of significant dangers in group processes which, if not countered, can result in worse decisions being made by groups of people than might have been made by a single decision maker.

There are a number of well known problems associated with group processes, some of which are discussed in the following sections.

2.4.1 Conformity

Conformity is often seen as simple ‘conformity to the majority’. In a well known experiment, Asch (1956, 1963) demonstrated a high level of willingness by people in a group to go along with the expressed opinions of the majority, even when these individuals knew that the majority opinion was incorrect. In these situations people can question their own judgements even though it appears that the majority opinion is wrong. A number of experiments have been undertaken to demonstrate these conformity effects. A meta-analysis of over 100 experiments employing different versions of Asch’s experimental approach identifies a linear relationship between conformity and the size of the majority (Bond and Smith, 1996), and that larger majorities will elicit more conformity than smaller majorities. However, increasing the group size beyond a certain point appears to result in diminishing effects on the level of conformity as does breaking of the unanimity of the majority (Brown, 2002: 128).

Deutsch and Gerard (1955:635) suggests that there are two explanations for these conformity effects:

- The need to depend upon others for information about the world and to test the validity of our own opinions, known as ‘informational influence’.
- The need for approval arising out of a wish not to seem different from the rest of the group – known as ‘normative social influence’. This normative influence should be reduced if people make their responses privately (Brown, 2002: 136).

In an experiment by Deutsch and Gerard (1955), conformity was reduced when responses were anonymous, and this conformity was reduced further when participants committed themselves by first writing down judgements on paper.

Associated with the conformity due to effects of the majority, are the possible effects which ‘deviates’, or individuals that hold a minority position, might have. In a meta-analysis of over 100 studies, Wood *et al* (1994:335) found that, while less influential than majorities, minorities can still have a persuasive influence on the group and can bring about changes in the opinions and actions of the majority. Minorities provide stimulation for thought processes within a group, and that attempts to suppress minority

views undermines the quality of decision-making. Minority views therefore provide a creative contribution to problem solving and decision-making and can stimulate divergent thought processes (e.g. Nemeth, 1986:30; Nemeth and Kwan, 1987:796)

Another reason for conformity is the need for a social identity. To be a member of a group is to adopt the norms and values of the group, and individual group members will be influenced by these norms. Whyte (1956), cited by Jennings (1994:63), identified what he termed the ‘Social Ethic’. The Social Ethic is concerned with members of a group putting the needs of the group before their own individual needs. Traits such as wanting to belong, fitting in and self-effacement in the light of group needs can result in an environment that which will inhibit individual initiative and the courage to exercise it against the majority group opinion, even where such individual initiative would lead to a better decision being made. The result of the Social Ethic is that group harmony often has a higher priority than obtaining the best decision.

The concept of ‘de-individuation’ is also important in this context. Diener (1980:210) defined a de-individuated person as someone who *“is prevented by situational factors present in a group from becoming self aware. De-individuated persons are blocked from awareness of themselves as separate individuals and from monitoring their own behaviour.”* Self-awareness is prevented when the group, not the individual, becomes the focus of attention. A de-individuated person may behave in a way that would normally be inhibited because he or she loses self-awareness and therefore is not fearful of punishment. Diener (1980:232) identified a number of possible positive and negative effects of de-individuation. For example, a de-individuated person may be more likely to contribute to charity, but may also be more likely to throw a rock in a riot.

The pressures to conform in groups can help bring about some form of consensus, but can also adversely affect an individual’s judgement in making a decision. The tendency to conformity in groups, with shared norms and other pressures for conformity, could result in a failure to consider the full range of options, and a willingness to discard any decisions that do not fit in with the aspirations of the group.

2.4.2 Groupthink

In extreme circumstances, the group cohesiveness caused by the Social Ethic can lead to a phenomenon known as Groupthink, a term defined by Janis (1972). Groupthink occurs in highly cohesive groups when group pressures for unanimity and agreement override the requirement of a decision making group to carefully evaluate the risks and benefits of alternative decisions. Janis (1972:9) identified a number of United States foreign policy problems caused by decisions made by groups exhibiting the symptoms of groupthink. One of the most well known of these decisions was the Bay of Pigs fiasco in which 1,400 Cuban exiles backed by the US Government were sent to Cuba in the 1960's and were quickly surrounded by 20,000 Cuban soldiers. Those not killed were ransomed back to the United States. Groupthink is also said to have contributed to the Challenger Space Shuttle disaster (Moorhead *et al*, 1991)

Janis (1972) has identified eight symptoms of groupthink:

1. Illusion of invulnerability. The group overestimate their ability to succeed against high risks and believe that they are immune from error.
2. Collective rationalisation. Problems that should not be ignored are rationalized away.
3. Illusion of morality. The group has an unquestioned faith in the logical, ethical and moral correctness of their decisions.
4. Shared Stereotypes. Group members develop shared stereotyped views of other groups and competing points of views.
5. Pressure for conformity. Members pressure each other to conform with the group views and accept the group consensus. Dissenting views are not acceptable.
6. Self-censorship. Group members convince themselves that they should avoid expressing opinions contrary to the group - members do not want to 'rock the boat'.
7. Illusion of unanimity. As there is not any expressed disagreement, unanimity with the group decision appears to be obtained. Silence is taken as agreeing with the decision.
8. Mind guards. Mind guarding occurs when individual members protect the group from information that appears to contradict its decisions.

To prevent groupthink, groups should ensure that disagreement and debate is encouraged, and that dissenting views are actively sought. Further methods to limit groupthink include not mistaking silence from individual members as agreement, and obtaining feedback on any decision from outsiders where possible.

2.4.3 Polarisation

Although groups are often thought to make ‘compromise’ decisions, research in the 1960’s found that groups tended to make ‘riskier’ decisions when compared to the preferences of the individual group members. This became known as the risky-shift phenomenon (Stoner, 1968: 442). Later research found that groups could also make more conservative decisions when compared to the preferences of the individual group members, and this effect of a group tending to make a more extreme decision (either more risky or more conservative) when compared to the preferences of the individual members is known as polarisation (e.g. Burnstein and Sentsis, 1981:215).

Isenberg (1986) found that polarisation was due to two reasons. The first reason is that group discussion will tend to exaggerate the initial positions of group members, which Brown (2002: 222) calls social comparison theory. For example, individuals who are a little conservative will tend to become more conservative after discussion. The second reason is that information consistent with the views held by the majority of members will dominate discussion and have a persuasive effect causing a polarisation effect. Brown (2002:222) also identifies a third reason for polarisation; this is termed social identify theory, where group members’ conform to in-group norms as opposed to out-group norms.

2.4.4 Higher Status Influence

Often participants of meetings come from different levels in the organisation and this can result in a number of process losses. Hofman (1978:108) reports on Torrance’s studies on problem solving in the US Air Force, which found that the lowest ranking member of a group was least likely to influence the group, even when he was correct. Hofman (1978:108), in summarising a number of studies, identifies the following reasons for this effect:

- Expecting to be able to influence, the higher status member may assert his ideas more forcefully
- A low status member may go along with the opinion of the higher status member, even when he believes that his opinion is correct
- There is a greater concentration on the ideas of the high status person, and the group has to spend a lot of time supporting or rejecting his views rather than searching for alternatives.
- The high status person may be ‘threatening’ to lower status members in a group – i.e. a lower status member may be afraid to criticise his boss, especially in a group setting. Therefore high status members can inhibit the free expression of ideas.
- A person in a leadership position is more likely to participate more actively in the group.

Hofman (1978: 110) identifies the above as barriers to the effective functioning of the group when an exchange of ideas is required, or when only one member of the group has the required information.

2.4.5 Social Loafing

Latane, Williams and Harkin (1979) have shown that as group size increases, the effort and the performance of each individual member decreases. This phenomenon is termed ‘social loafing’. People in groups exert less effort and less concentration than they otherwise would if working individually. Social loafing can be avoided if each individual feels that their contribution can be identified and that their contribution makes a significant difference to the group’s performance. It is also important to bear in mind that full participation in the decision process is often the key to commitment to the decision and successful implementation.

2.4.6 Group Process Gains and Losses

The proceeding discussion has highlighted some of the reasons why groups are used, and some of the problems of group processes. These are often referred to as Group Process Gains and Group Process Losses. Nunamaker (1991:46) has identified and summarised a number of these process losses and gains, and these are shown in Table 1.

| Common Process Gains | |
|-------------------------------|--|
| More information | A group as a whole has more information than any one member |
| Synergy | A member uses information in a way that the original holder did not because that member has different information or skills |
| More objective evaluation | Groups are better at catching errors than are the individuals who proposed ideas |
| Stimulation | Working as part of a group may stimulate and encourage individuals to perform better |
| Learning | Members may learn from an imitate more skilled members to improve performance |
| Common Process Losses | |
| Air time fragmentation | The group must partition available speaking time among members |
| Production blocking | This has three elements: <ol style="list-style-type: none"> 1. Attenuation blocking: this occurs when members who are prevented from contributing comments as they occur, forget or suppress them later in the meeting because they seem less original, relevant or important. 2. Concentration blocking: Fewer comments are made because members concentrate on remembering comments (rather than generating new ones) until they can contribute them. 3. Attention blocking: New comments are not generated because members must constantly listen to others speak and cannot pause to think. |
| Failure to remember | Members lack focus on communication, missing or forgetting the contributions of others |
| Conformance Pressure | Members are reluctant to criticise the comments of others due to politeness or fear of reprisals. |
| Evaluation apprehension | Fear of negative evaluation causes members to withhold ideas and comments. |
| Free riding | Members rely on others to accomplish goals due to cognitive loafing, the need to compete for air time, or because they perceive their input to be unneeded |
| Cognitive inertia | Discussion moves along one train of thought without deviating because group members refrain from contributing comments that are not directly related to the current discussion. |
| Socialising | Non task discussion reduces task performance, although some socialising is usually necessary for effective functioning. |
| Domination | Some group member(s) exercise undue influence or monopolise the group's time in an unproductive manner. |
| Information overload | Information is presented faster than it can be processed. |
| Coordination problems | Difficulty integrating member's contributions because the group does not have an appropriate strategy, which can lead to dysfunctional cycling or incomplete discussions resulting in premature decisions. |
| Incomplete use of information | Incomplete access to and use of information necessary for successful task completion |
| Incomplete task analysis | Incomplete analysis and understanding of task resulting in superficial discussions. |

Table 1: Group Process Gains and Losses (Nunamaker *et al*, 1991:46)

2.5 Decision Making Techniques for Groups

A number of manual techniques have been developed to try to limit some of the negative effects of group processes described above. Three of the most common are

briefly discussed below (see Cherrington, 1994, Chapter 14, for further details of these methods).

2.5.1 Brainstorming

The purpose of brainstorming is to enhance creativity in group discussions by creating an environment that stimulates the generation of new ideas. Four basic rules of brainstorming are:

1. No ideas are criticised
2. Freewheeling (the free association of ideas) is encouraged
3. The quantity (rather than quality) of ideas is stressed
4. Participants are encouraged to improve on the ideas of others - this is known as “hitchhiking”.

Recent research has criticised brainstorming as a process that is more likely to inhibit creative ideas rather than encourage them (Cherrington, 1994: 600). For example, in an experiment that compared real brainstorming groups with ‘nominal’ groups (Taylor *et al*, 1958), the nominal groups outperformed the real groups with respect to mean total of ideas produced, mean number of unique ideas produced, and three additional measures which weighted the ideas produced differentially with respect to quality. This particular study concluded that “*group participation when using brainstorming inhibits creative thinking*” (Taylor *et al*, 1956: 43). Reasons given for this are:

- An individual may still feel less free of possible criticism, even when the criticism is not expressed at the time.
- Group participation may reduce the different number of ideas produced.

2.5.2 The Delphi Method

The Delphi method (see, for example, Holsapple and Whinston, 1996) was developed at the Rand Corporation in the 1950's as a method of combining the information and insights of a group of experts but without the undesirable effects of interaction between members of the group. It is used to develop a consensus between experts, as is often used as a forecasting technique (Huber, 1982:219). The normal procedure is as follows:

- Identify a set of experts on a particular issue
- Each expert provides a written assessment regarding the issue of concern along with supporting evidence
- These opinions are submitted to the Delphi coordinator
- The Delphi coordinator edits, clarifies and summarises the opinions
- These opinions are then provided as anonymous feedback to all participants along with a further set of questions or issues
- Questions and feedback continue in writing for several iterations, becoming increasingly more specific, until consensus is reached, or the panel members no longer change positions

Proponents of the Delphi method claim that it has three features that avoid the group problems identified earlier. These are: (i) anonymity, (ii) opportunity for opinion revision and (iii) summary feedback. The two intended purposes of the Delphi method are to increase the degree of agreement or consensus among the experts and increase the accuracy of the overall group response.

However, the Delphi method can be extremely time consuming with much of the elapsed time non functional (Huber, 1982: 220). A Delphi study will take many weeks, or even months, to complete.

2.5.3 The Nominal Group Technique

The nominal group technique (NGT) incorporates some of the features of brainstorming and the Delphi technique. The NGT procedure involves the following steps:

1. Silent generation of ideas in writing
2. Round robin listing of ideas on a flip chart
3. Group discussion of ideas in sequence
4. Silent ranking of ideas
5. Discussion of rankings
6. Silent re-ranking of ideas

This structured form of elicitation appears to be successful in generating more unique ideas than conventional interacting group meetings (Van de Ven and Delbecq, 1974:620). An example of the use of the Nominal Group Technique is described by Teltumbde (2000) who provides a methodological framework for dealing with evaluating Enterprise Resource Planning (ERP) projects based on the Nominal Group Technique.

2.5.4 The Value of Dialogue in Groups

Two of the three methods described above to support decision-making groups require the participants in the groups to enter into a dialogue. Indeed, one of the criticisms of brainstorming is that participants may still be concerned about criticism of their ideas. Dialogue in a group implies collective thought, learning to think together in order to question the collective assumptions organising has created, as opposed to debate that has adversarial connotations. Such assumptions underpin and inform both organisational and group behaviour. The process of dialogue involves the surfacing and exploration of differences of meaning and opinion on critical issues in a non-adversarial way.

The central purpose of dialogue is to establish a genuine meeting and inquiry, and a dialogue setting should *“allow a free flow of meaning and vigorous exploration of the collective background of their thought, their personal predispositions, the nature of their shared attention, and the rigid features of their individual and collective assumptions.”* (Isaacs, 1993:25)

Buber (1965: 86) argues for a 'genuine dialogue' where if participants can express without reserve and without a desire for semblance, more fruitful insights can be obtained and "*the inter-human opens out what otherwise remains unopened*" (Buber, 1965: 86).

Dialogue can be seen as a collective way of opening up judgements and assumptions to processes of change. An aim of encouraging dialogue in groups is to produce an environment in which people are consciously participating in the creating of shared meaning and the development of new and aligned actions (Dixon, 1999:136).

The value of dialogue is that it can form the basis for learning and change. Certainties that seem to hold individuals and groups in fixed positions can be sufficiently loosened so that new possibilities can come into existence. For both practitioners and researchers, the process of dialogue can be seen to provide an avenue for communication and collaborative learning within and between groups and teams (e.g. Isaacs, 1993).

2.6 Group Support Systems

The development of Group Support Systems (GSS) is a response to the perceived need for developing better ways to aid the group decision process, and other group processes, by using technology to support the decision making process. As with traditional Decision Support Systems, there are a number of definitions that attempt to define the concept of the Group Support System. DeSanctis and Gallupe (1985:3) define a Group Decision Support System as "*An interactive, computer based system which facilitates the solution of unstructured problems by a set of decision makers working together as a group.*" A more recent definition of Group Support Systems is given by Nunamaker *et al* (1997:165) who says that GSS are "*interactive computer-based environments that support concerted and coordinated team effort towards completion of joint tasks.*"

The objectives of a GSS are to reduce the negative aspects of group work whilst attempting to enhance the positive effects. Huber (1982:212) in arguing the case for GDSS to be adopted by decision making groups, states that:

The actual effectiveness of a problem solving group is equal to the potential effectiveness that follows from the combined inputs of the members minus the losses in effectiveness that follow from the group processes plus the gains in effectiveness that follow from the group processes

(Huber, 1982:212)

Where:

- Potential Effectiveness indicates those times when the group performs its tasks with the group members satisfied.
- Potential Losses include the loss in decision quality resulting from some members not having the opportunity to contribute their knowledge. This can result from many of the problems associated with groups discussed earlier (e.g. dominant influence by some individuals, pressures for conformity, miscommunication, social loafing, polarisation).
- Potential Gains include the gain in decision quality resulting from one group member thinking of a new and useful idea as a result of awareness of the contribution of other members.

Although many of these process issues can be addressed by the introduction of process techniques such as Delphi Technique and Nominal Group Technique, Nunamaker *et al* (1991) claims that GSS effectively enhances the group process beyond manual process techniques by reducing some process losses and improving the potential for process gains. Huber (1982) gives examples of how both the Delphi method and Nominal Group Technique can become more effective through the use of a Group Support System, primarily through enhanced information exchange within the group.

Nunamaker *et al* (1997) identifies a number of group process gains through the use of a GSS, including improved communication, improved structuring and focussing problem solving efforts, and improved meeting productivity.

2.6.1 Characteristics and Categories of GSS

Group Support Systems can come in many different shapes and sizes (see for example Appendix A). According to Finlay and Marples (1992:99) there are a number of characteristics that will be common across many types of GSS, including:

1. Communication facilities between group participants
2. Enhanced modelling and interface facilities to permit voting and ranking for developing consensus
3. Both qualitative and quantitative decision aids as appropriate
4. Decision aids with which the participants are comfortable
5. Decision aids that are transparent in operation, so that the participants will understand and so use the results.
6. Decision aids that are flexible so that they do not constrain problem formulation.

DeSanctis and Gallupe (1987:593) identify three levels of GSS:

Level 1 – These GSS provide technical features aimed at removing common communication barriers, such as large screens for instantaneous display of ideas, voting solicitation and compilation, anonymous input of ideas and preferences, and electronic message exchange between members. It is thus primarily a communication medium.

Level 2 – These GSS provide decision modelling and group decision techniques aimed at reducing uncertainty and noise that occur in the group's decision process. Modelling tools to support analyses that ordinarily are performed in a qualitative fashion, such as multi-attribute utility methods, can be introduced.

Level 3 – These GSS can include expert advice in the selecting and arranging of rules to be applied during a meeting.

According to this taxonomy of GSS levels, the Teamworker GSS used as the basis for this portfolio contains features of both Level 1 and Level 2 type systems.

Although most group decision meetings are normally face-to-face meetings with all participants in the same meeting room, information technology now makes it possible for members of a group to be at different locations and even in different time frames. DeSanctis and Gallupe (1987:598) have identified four categories of GSS that depend upon the location of the group members and the size of the group, shown in Figure 1.

| | | GROUP SIZE | |
|---------------------|-----------------|--------------------------------|---------------------------------|
| | | Smaller | Larger |
| MEMBER PROXIMITY | Face to Face | Decision Room | Legislative Session |
| | Dispersed | Local Area Decision Network | Computer-Mediated Conference |

Figure 1: A Taxonomy of GSS Environmental Settings (DeSanctis and Gallupe, 1987: 598)

The four types of environmental settings are:

1. Decision Room - this is a traditional meeting room with additional electronic aids, meeting within a fixed block of time.
2. The Legislative Session – If there is a large membership of a group, the facilities of the GSS may need to be reduced. DeSanctis and Gallupe (1987) envisaged this type of environment for Government legislative meetings and other meetings with formalised procedures and large memberships.
3. Local Area Decision Network - this is a GSS developed to support teams of people who work within close proximity to each other whilst sitting in their normal offices.
4. Computer Mediated Conference – this is where a large number of people wish to participate in a decision making meeting, and are physically separated from each

other. Long distance telecommunications networks and group decision software will need to be combined.

According to this taxonomy of GSS environmental settings, the Teamworker GSS is used within a Decision Room setting. Groups of people have come to a room that includes the Teamworker GSS, at a point in time.

2.6.2 The Role of Task

An important issue that must be considered with GSS design is the nature of the task that confronts a group. There are a number of frameworks for classifying tasks, for example Shaw (1973) identified six dimensions along which group tasks varied (e.g. task difficulty, solution multiplicity). Hackman and Morris (1975:53) related task to group interaction, and identified three different task types (generate ideas, discussion, problem-solving). A well-known example of task classification is the task circumflex, shown in Figure 2 which has been developed by McGrath (1984:61).

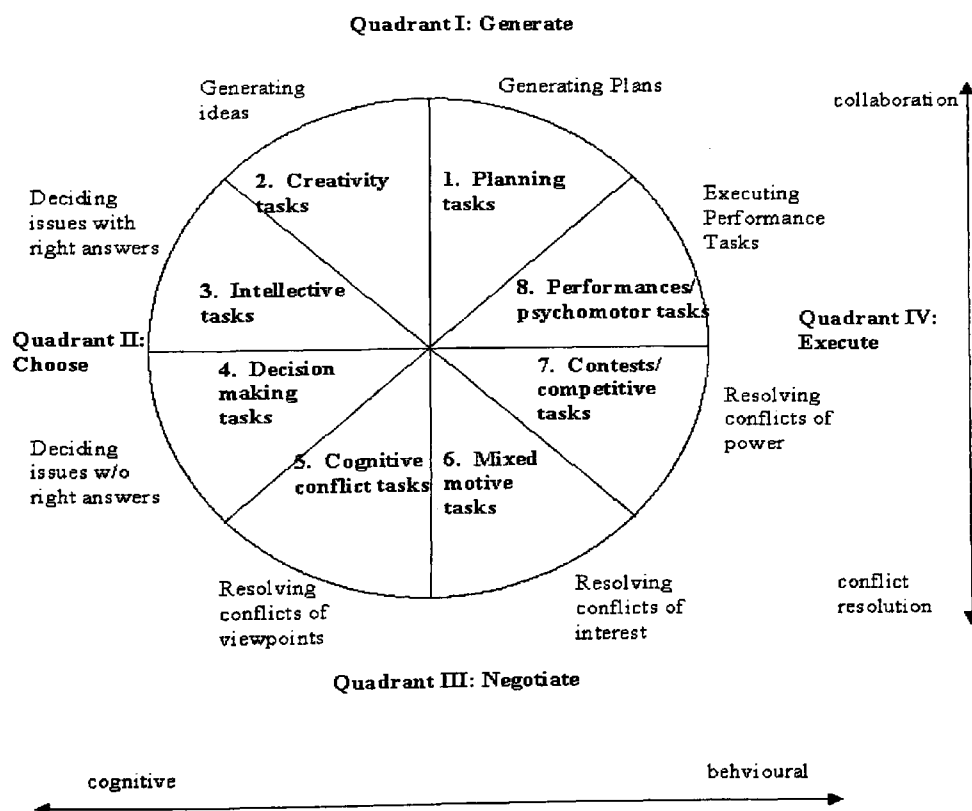


Figure 2: McGrath's Task Circumflex (McGrath, 1984:61)

The task circumflex has been used to relate the capabilities of GSS to task (e.g. Hollingshead *et al*, 1993; DeSanctis and Gallupe, 1987; Nunamaker *et al*, 1989). Bui and Sivasankaran (1990) identify tasks of high complexity of particular significance for GSS use, and that GSS should not be used with tasks of low complexity because of the overhead associated with GSS. Benbasat and Lim (1993) disagree, and found that groups working on tasks of lower complexity benefited more through the use of a GSS than those groups working on higher complexity tasks. Benbasat and Lim (1993) also identify that most GSS experimental research has concentrated on either generating tasks (Quadrant I) or choosing tasks (Quadrant II) or both. The Teamworker GSS has been used by groups concerned with task types 1, 2, 3, 4 and 5 from the task circumflex.

2.6.3 Interacting with a GSS

As well as different types of group support system, a number of different methods by which group members can interact with a GSS can be identified. Three ways in which this interaction occurs can be identified (Sprague and Watson, 1996:335).

Chauffeured approach

In this approach, one person in the meeting takes orders from the group members and implements them using the GSS technology. The chauffeur may be a group member but need not be so, and is likely to be the only person with access to the GSS technology.

Supported approach

In this method each group member is given access to a workstation or an individual handset but a facilitator can direct the group members as to when and how to use the system. A facilitator may have access to features not available to group members. The meeting proceeds using a mixture of verbal and electronic interaction. This is the approach typically used by the Teamworker GSS. See Phillips and Phillips (1993) for more information on the role of a facilitator.

Interactive Approach

In this third approach, the parallel, anonymous, electronic communication channel with a group memory is used for almost all interaction; virtually no one speaks. Although there may be a public screen, the group memory may be too large to fit onto a screen, and is therefore accessed by group members electronically.

2.7 Types of Group Support System

A variety of Group Support Systems have been developed to support decision-making groups and other group processes, and these GSS have mostly been developed by either academics in the GSS field or by professional facilitators. GSS developers claim that their systems can improve communication within a group and reduce the negative aspects of groups. However, different GSS will vary according to their use of technology, the methods used to model the group problem, and the way that information can be shared by the group members. Appendix A distinguishes four types of GSS that are commercially available for management groups.

A number of researchers have attempted to classify GSS, for example Finlay and Marples (1991:4) use the extent to which information technology supports the group process and the scope of this support to differentiate between systems, and Finlay (1991: 102) identifies high level, middle level and low level systems.

- High level systems – comprise dedicated meeting rooms and networked personal computers often with a group screen. Examples of this type of system include GroupSystems (e.g. Nunamaker, 1991; Davison, 2001) and SAMM (e.g. Zigurs, 1999; Sia *et al*, 1997). Watson *et al* (1994:104) refers to these systems as w-GSS (where the w stands for workstation).
- Middle level systems – comprise a laptop computer, individual voting handsets and a large feedback screen. Examples of this type of system include OptionFinder (e.g. Finlay, 1991; Flexner and Wheatley, 1997) and Teamworker (e.g. Read *et al*, 2003). Watson *et al* (1994:104) refers to these systems as k-GSS (where the k stands for keypads).

- Low level systems – comprise a single PC running software that will take inputs from members of the group. This type of system requires the group members to identify their opinions verbally to enable an analyst/operator to manually enter them into the computer software. Examples of this type of system include Hiview (e.g. Finlay and Marples, 1991) and COPE (e.g. Ackerman, 1996). Watson *et al* (1994:104) refers to these systems as f-GSS (where the f stands for facilitator).

There are many more GSS commercially available. For example, a report by Unisys (1990) for the US Department of Transportation identifies thirteen commercial and research groups that were working on different group decision support systems in 1990.

2.8 Factors That Affect GSS Use

Nunamaker *et al* (1991:45) contends that the use of a GSS is contingent on a myriad of variables including group task, context and technology factors that differ from situation to situation. Group characteristics that can affect processes and outcomes include group size, group proximity, group composition and group cohesiveness. Task characteristics include the activities required to accomplish the task, such as making a decision choice or generating ideas. Context characteristics include organisational culture, time pressures and reward structures. Meeting outcomes, such as effectiveness, efficiency, decision quality, depend upon the interaction within the meeting process of these factors and the GSS technology. One cannot make generalised statements, such as “a GSS improves task performance or group effectiveness”, as such statements must be qualified by the situational factors and the type of GSS used.

Nunamaker *et al* (1991:44) identifies a high level view of a research framework that included elements of group, task, context and Electronic Meeting System (EMS). This high level research model is shown in Figure 3.

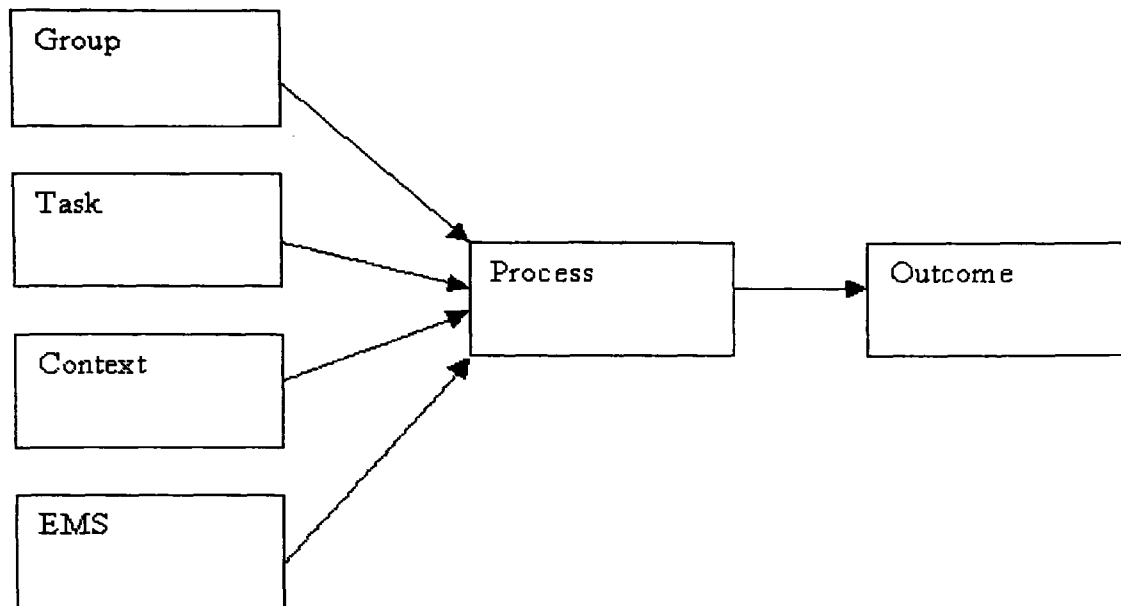


Figure 3: High Level Research Model (Nunamaker *et al*, 1991: 44)

A number of other more detailed frameworks have also been developed. Pinsonneault and Kraemer (1989:199) developed an Input-Process-Outcomes (IPO) framework to analyse experimental research on GSS. Four broad sets of factors were identified; the context, the process, the task-related outcomes and the group-related outcomes. Each of these factors were then divided into a number of variables, which could be used to analyse the empirical research identified in the literature. Tung and Turban (1998: 180) extended the Pinsonneault and Kraemar framework to include the additional outcome of Impact on the Organisation when considering distributed group support systems. Another adaptation of this model has been proposed by Petrovic and Krickl (1994:234) to analyse traditionally moderated versus computer supported brainstorming and this has been used by Batenburg and Bongers (2001) in their study of a participatory policy exercise in which citizens were actively involved in the development of a city vision using a GSS.

In their analysis of over 200 GSS research articles, Fjermestad and Hiltz (1999:11) developed a theoretical framework which included a comprehensive factors model developed from a number of other frameworks, including DeSanctis and Gallupe (1987), Dennis *et al* (1988), Pinsonneault and Kraemer (1990), Hiltz *et al* (1991), and Nunamaker *et al* (1991). The resulting theoretical framework is conceptualised as consisting of four major categories of variables: contextual (independent) variables,

intervening variables, group adaptation processes, and outcomes. Each of these major categories of variables is subdivided into a number of other variables.

Stevens and Finlay (1996) have developed a research framework that has six major components, and includes organisational issues as well as group issues. The six major components are divided into three elements:

1. Context - the organisational environment, the group context and the process context
2. Outcomes from the process – substantive outcomes and process performance indicators (PPIs)
3. The process itself

Within the six major components, 16 macro variables are identified. Within the 16 macro variables 90 variables are selected that characterise an issue-handling situation and its outcomes. The purpose of this framework is to provide a generally agreed framework within which research can be conducted and results determined. For laboratory experiments, the framework can be used to guide design. For less controllable case histories, the framework should guide the descriptions (Stevens and Finlay, 1996:538).

A further factor that will affect the use of a GSS within an organisation is the availability of an internal ‘champion’ from within the organisation who can motivate people within an organisation to use a GSS. In a documented GSS failure, Bidgoli (1996:64) identified the reasons for a GSS implementation at the Indian Health Service, Tuscon, to be a lack of an internal champion, the perceived lack of need for such a system from the organisational management and the failure to match technology with the users’ needs.

2.9 Research Studies

There is increasing research into whether GSS reduce the process losses and increase the process gains therefore producing a more effective meeting, as suggested by Huber (1982). A number of studies, both experimental and field based, have been undertaken

to try to resolve this issue. For example, Nunamaker *et al* (1993) draws the following conclusions on the use of GSS from a number of field studies:

- Parallel communications allowed by GSS encourages greater participation and reduces the likelihood of a few group members dominating the proceedings.
- Anonymity reduces apprehensions about participating and lessens the pressure to conform, allowing for more candid reactions.
- Existence of a group memory (i.e. stored group inputs) makes it easier for participants to pause and ponder the contributions of others during the session, as well as preserving a permanent record of what has occurred.
- Process structuring helps to keep the participants focused on making the decision, reducing tendencies toward digression and unproductive behaviours.
- Task support and structuring give participants the ability to select and derive needed knowledge.

However, research evidence on the effectiveness of GSS is contradictory, especially when experimental studies (often laboratory based) and field studies are compared. Experimental studies have mostly been concerned with considering the effect on specific variables of varying the GSS support facilities, or in comparing GSS supported groups with groups which have no support or manual support. Field studies are concerned with investigating the effects of GSS when used with real organisational decision-making groups.

2.9.1 Experimental Studies

The majority of research studies with GSS have involved experimental research, often using student groups in a laboratory setting. Out of a total of 131 empirical papers concerned with GSS events and processes identified by Pervan (1998:156), over 55% were laboratory studies, with the remainder a mix of experimental field research, field studies, interpretivist and positivist case studies, survey research and instrument development. The reasons for the preponderance of laboratory experiments in GSS research may be that GSS is amenable to this style of research as there are a large number of dependent variables relating to process and/or outcome to study, and that most of this research has been undertaken in US universities where laboratory

experimentation is an accepted research approach and is emphasised in their PhD programmes (Pervan, 1998:156). DeSanctis (1989:63) identifies a number of advantages of using laboratory experiments as a research setting when studying IT design and small groups, in that the researcher can isolate behaviours that are very difficult to examine in naturally occurring groups. There are, however, a number of criticisms of this practice, in terms of the relevance and use of the results of laboratory experiments for real world situations. It is difficult to generalise contrived tasks and student groups with little vested interest in the outcome of the meeting to real world situations involving managers working on real problems and with vested interests in the outcomes. Therefore there are concerns about the external validity of such an approach. This issue is further considered in section 2.11.

Examples of experimental research into GSS include the following:

- Gear, Marsh and Sergent (1985). Objective – to study the effects on group behaviour when given feedback of participant feelings regarding the progress of meetings.
- Siegel *et al* (1986). Objective – to study the effects of computer mediated communication on communication efficiency, participation, interpersonal behaviour and group choice.
- Gallupe *et al* (1988). Objective – to study the effects of GSS in group problem solving.
- Jarvenpaa *et al* (1988). Objective – to study the effects of groups using a GSS to work on unstructured problems.
- Turoff and Hiltz (1982). Objective – to compare the process and outcomes of face-to-face meetings with a GSS.
- Watson *et al* (1988). Objective – to study the effects of using a GSS to facilitate group consensus.
- Zigurs *et al* (1988). Objective – to study the effects of influence behaviour upon the group process.
- Zigurs (1989). Objective – to study the impact of GSS on influence behaviour in decision making groups

- Hiltz *et al* (1989). Objective – to study the effects of anonymity on the group process.
- Jessup *et al* (1990a). Objective – to determine whether anonymity influences the group interaction process.
- George *et al* (1990). Objective – to study the effect of communication medium, assigned leader and anonymity when using a GSS.
- Connolly *et al* (1990). Objective – to evaluate the effects of anonymity on the performance of groups using a GSS.
- Jessup and Tansik (1991). Objective – to study the effects of anonymity and proximity when using a GSS.
- Lim *et al* (1994). Objective – to study the effects of GSS and leadership.
- Huang *et al* (1999). Objective – to study the compensating effects of GSS on group performance.
- Rees and Koehler (2000). Objective – to study the effects of GSS and leadership.
- Reing (2002). Objective – to study meeting satisfaction in GSS and face-to-face groups.

A number of reviews of experimental research have been produced, and some of these are summarised below.

Dennis, George, Jessup, Nunamaker and Vogel (1988)

This was an early review of the experimental literature, and included four different research streams and 19 separate experimental studies. The four streams of research identified were:

1. Local Area Decision Network v Decision Room
2. Local Area Decision Network v No Computer Support
3. Decision Room v No Computer Support
4. Decision Room Configuration

By far the largest number of articles was included in the third stream, Decision Room v No Computer Support, where 10 articles were identified. In many of the articles in this stream, groups receiving no computer support either use the same structure as the GSS

groups or they use no structured process at all. Seven dependent variables were analysed within these 10 studies:

1. Decision Quality
2. Consensus
3. Time to Decision
4. Participation
5. Inhibition
6. Satisfaction with Process
7. Satisfaction with Outcome

The findings for these variables were inconsistent across all 10 studies. For example, quality of decision was rated better using the GSS in five of the ten studies, whereas in 5 studies the GSS had no effect or produced lower quality decisions. Similarly, 4 studies found no difference in satisfaction with the process between GSS and non-GSS groups, 2 studies found reduced satisfaction using the GSS, and 1 study found increased satisfaction using the GSS. Two studies considered the affect of the GSS on group consensus – one study identified that consensus was less likely when using a GSS and in the other study consensus was not affected by the use of a GSS.

Two studies were included in the fourth stream, Decision Room Configuration. The main feature of these studies was that the anonymity of participants was varied. Both studies found that anonymous GSS groups generated significantly more comments.

Pinsonneault and Kramar (1989, 1990)

Pinsonneault and Kramar (1989, 1990) developed a framework for analysing the impacts of GSS on groups, and applied the framework to empirical research (mostly laboratory work, but also some field experiments) that had been undertaken. The framework elements consisted of context, process, task related outcomes and group related outcomes, and these elements were further divided into 13 major variables. 12 studies were identified that were concerned with Level 1 type GSS, and 16 studies were identified that were concerned with Level 2 type GSS.

Although not all studies were in complete agreement, Pinsonneault and Kramar (1990: 152) identified that the results of the studies consistently suggest that the Level 2 GSS affect group processes and outcomes as follows:

1. Increased depth of analysis.
2. Increased task-orientated communication and clarification efforts.
3. Increased degree of participation and decrease the domination by a few members.
4. Increased consensus among members of the group.
5. Decreased decision time.

The following conclusions were reached with regard to Level 1 GSS:

1. Increased depth of analysis.
2. Increased participation and decreased domination by a few members.
3. Decreased co-operation.
4. Increased time to reach a decision.

Benbasat and Lim (1993)

Using a meta-analytic methods, Benbasat and Lim (1993) considered 31 experimental studies which compared GSS and non-GSS conditions as independent variables. Most of the experimental studies considered were laboratory studies, which Benbasat and Lim (1993: 455) accepted was a limitation of the study. Benbasat and Lim (1993: 444) found that GSS, when compared with no-GSS use groups, had:

1. Positive effects on decision quality, the number of alternatives generated, the time to reach a decision, and equality of participation
2. Negative effects on consensus and satisfaction with the outcome
3. Neutral effects on satisfaction with process and confidence with outcome

Additionally, a number of moderating factors were identified. These included task complexity where, in contrast to Bui and Sivasankaran (1990), this study found that groups working on tasks of lower complexity benefited more through the use of a GSS

than those groups working on higher complexity tasks. Other moderating variables included:

- Group size – groups of large sizes benefited more from GSS use
- Groups with participants from different levels of a formal hierarchy had reduced satisfaction and took longer to reach a decision
- Groups using a Level 2 GSS achieved higher satisfaction, decision quality and consensus

Pervan (1994)

Pervan (1994) looked at 95 studies (mostly laboratory experiments). He identifies that there is a great variety of measures used to examine GSS “success” and comes to the following conclusions regarding the effects of a GSS on the group in a laboratory setting:

- Satisfaction with the process using GSS is inconclusive, with no discernable trend.
- Effect on decision time is varied. Out of 6 laboratory experiments, 3 showed reduced decision time compared with manually supported groups, two studies had no effect, and one study had increased decision time when compared to manually supported groups.
- In only 5 out of 16 laboratory studies did the GSS group obtain a better solution than manually supported groups, in 10 studies there was no difference, and in a further study the GSS was found to have a negative effect on decision quality.
- 18 laboratory experiments that considered consensus were identified. Conclusions regard to consensus is inconclusive, with an even distribution among those studies between GSS being more effective, having no effect, and being less effective.

Fjermastad and Hiltz (1999)

In a thorough search of the literature, Fjermasted and Hiltz (1999) reviewed over 200 different controlled experiments that had been published in the academic literature (both journals and conferences). A theoretical framework was developed that provides complete coverage of factors present in the literature., and includes the elements of

contextual factors, intervening factors, adaptation factors and outcome factors. These elements are then divided into 17 major variables, and these are then further subdivided.

A number of dependent and independent variables have been analysed in the 200 plus studies. Independent variables include task support, process structure, design, communication mode, group characteristics, task characteristics, context and methods. Dependent variables include structuration, process variables, process issues, process gains and losses, role outcomes, efficiency, effectiveness, satisfaction, consensus, usability.

Many of the studies reviewed concerned relatively small groups - 72% of the studies concerned groups of 5 members or less (Fjermestad and Hiltz, 1999: 27). Yet Fjermestad and Hiltz also identify that GSS appears to be more helpful to larger groups (Fjermestad and Hiltz, 1999:27)

The general conclusion is that:

Overall, the results suggest that there is an overwhelming tendency to find 'no significant difference' between unsupported face-to-face modes and the types of group support systems that have been studied thus far. Less than one fifth of the findings, overall, support hypotheses that GSS use is better than face-to-face methods

(Fjermestad and Hiltz, 1999:56).

However, this conclusion is moderated to some extent by task type and group characteristics. The majority of the experiments involved group sizes of between 3 and 5 participants, and the vast majority of participants in the groups were undergraduate students (Fjermestad and Hiltz, 1999:42).

On the basis of these results, Fjermestad and Hiltz (1999:58) identify features in an experimental design that will be more likely to generate relatively positive results. These include:

- Use of a "level 2" system with sophisticated analysis tools

- Use subjects who are likely to be knowledgeable and motivated about the task, such as graduate students rather than undergraduates
- Aggregate the subjects in medium-size to large groups – at least six, ten or more is better
- Give the groups a facilitator (and plenty of time)

2.9.2 Field Studies

According to Pervan (1998:156) types of field research into GSS include field experiments where experimental controls are imposed in a natural setting, field studies where variables are measured in a natural setting by means of a questionnaire, positivist case studies with no experimental design or controls, interpretivist case studies where the researcher takes an interpretivist stance using approaches such as grounded theory, ethnography and phenomenology, organisational surveys and instrument development.

Examples of field studies include:

- Butterworth (1989). Objective – to describe how a GSS was used to explore relocation options for the Bank of England's registrar department.
- Nunamaker *et al* (1989). Objective – to explain the findings of an exploratory field study concerning the effects of implementing a GSS at an IBM manufacturing site.
- Dennis *et al* (1990). Objective – to explain the effect of using GSS technology with large groups (31 participants) at Burr-Brown company.
- DeSanctis *et al* (1991). Objective – to describe the effect of using a GSS for quality improvement teams with the Inland Revenue Service and the National Treasury Employees Union.
- Vickers (1992). Objective – to describe how a GSS was used to collect judgement and opinion from experts on the future business environment for the automobile industry.
- Balthazard and Gargeya (1995) – Objective – to explain how a GSS can be used to support Quality Function Deployment.
- Tavana *et al* (1996). Objective – to describe how a GSS can rank job candidates.

- Briggs *et al* (1998a). Objective – to investigate diffusion and adoption factors in an 18 month implementation of a GSS for the staff of the US Navy’s Commander, Third Fleet.
- Banks (2001) – Objective - to describe the use of different types of GSS to explore student evaluations.
- Adkins (2002) – Objective – to investigate use of a GSS to facilitate a strategic planning process with the United States Air Force.

There is not as much field research published as experimental research. This may be because not all field studies are formally documented and submitted for publication (Dennis *et al*, 1989: 300; Quaddus *et al*, 1998:39). However, a number of authors have attempted to review the outcomes of field research, and some of these are presented below.

Dennis, Nunamaker and Vogel (1989)

This relatively early work was only able to identify six published articles that could be termed field study research in GSS. However, in each of these six studies, the GSS appeared to have positive effects in terms of decision time, and to have high satisfaction ratings.

Pinsonneault and Kraemer (1989, 1990)

The small number of field studies considered in this review identified:

- Increased depth of analysis and task orientated communication
- Greater participation by members of the groups
- Reduced dominance by a few members
- Increased consensus reaching
- Inconsistent results on decision time

The authors express a limitation to these findings as most results are impressionistic in nature and obtained in case studies with no control groups, and the selection of participants was often done on a voluntary basis.

Nunamaker et al (1993)

In a discussion of the GSS empirical research undertaken by Nunamaker and colleagues at the University of Arizona, Nunamaker *et al* (1993) identified the following from the field studies reviewed:

- GSS tends to produce more effective outcomes, especially with larger groups
- GSS tends to produce significant time savings in field studies
- GSS tends to produce high satisfaction ratings

Pervan (1994)

As well as considering experimental studies, Pervan (1994) also looked at some field studies in his meta analysis of the literature on GSS effectiveness. For field studies, he found:

- Eight out of ten field studies reported higher satisfaction in process when using a GSS.
- All field studies reported which measured outcome and overall satisfaction, satisfaction with a GSS was higher.
- On the basis of case study evidence, five out of five case studies reported that using a GSS was more “effective” than using a manual process.

Chun and Park (1998)

Chun and Park (1998) compared experimental and field studies. Eighteen field studies were identified from the literature, each of which measured different variables.

Analysing the results of each of these field studies, Chun and Park (1998:315-319) find:

- Out of ten studies that considered time to decision, nine studies found improvement through use of a GSS.
- Out of fourteen studies that considered decision quality, thirteen found improvement on decision quality through use of a GSS.

- All of the fourteen studies that measured satisfaction with process and/or outcomes produced high satisfaction measures when using a GSS.
- All eleven studies that measured decision confidence produced high decision confidence measures when using a GSS.
- All eleven studies that considered participation reported improved participation when using a GSS.
- One study reported reduced conflict, and 6 studies reported higher conflict when using a GSS.

2.10 Handset Based Group Support Systems Research

Section 2.7 identified some different types of GSS, and Appendix A distinguishes four different types of GSS that make varying use of information technology. It appears, however, that only a small number of systems have been the subject of much of the research undertaken. Pervan (1998:155) found that, of the 234 papers reviewed in his study, virtually all used high level systems, as defined by Finlay (1991:102), and a large proportion of these used GroupSystems. Only four of the 234 papers reviewed used low level systems, these being Hiview and COPE, and none considered middle level systems.

Most research into GSS is United States focussed, and is concentrated on the development and use of the high level GSS. Some research has also been undertaken with low level GSS. This research has been mainly focussed in the UK where many of the low level systems have been developed.

However, there has been limited research into middle level handset based GSS (or k-GSS) when compared to high level GSS. This is despite the use of such systems by a number of organisations. Out of the three levels of system, Finlay (1991:102) identifies the middle level GSS as being ideal for average size meetings and can be easily carried from room to room. Watson and Bostrom (1991:11) identify two strengths of middle level group support systems: their portability which enables them to be used in a wide number of settings, and the display of voting which is flexible and easy to use.

In an early application, Gear *et al* (1985) used a hard-wired k-GSS to study the effects on group behaviour when given feedback of participant feelings regarding the progress of meetings. Further research into the application of these types of GSS has been carried out by myself with colleagues (e.g. Gear and Read, 1988, 1993; Read and Gear, 1989, 1993, 1994, 1999; Gear *et al*, 1993, 1994, 1996, 2003; Read *et al*, 1998, 2000a, 2000b, 2003; Baron *et al*, 1999; Minkes *et al*, 1999; Jones *et al*, 2001). Other published articles include Banks (2001), who considered the use of handset based systems to obtain student feedback evaluation, Davies (1989) who looked at handset based technology for supporting groups in retail marketing, Irving and Hunt (1994) who looked at how handset based systems can support student groups, and Flexner (1995) and Flexner and Wheatley (1997) who consider how handset based technology can support management groups.

Watson *et al* (1994:121) investigated the perceptions of facilitators who have used handset based systems. This investigation identified the following facilitator perceptions:

1. Anonymity is beneficial
2. Meetings can have more participants without loss of effectiveness
3. Meeting participation is improved
4. Meetings are more focussed
5. Meeting planning is more important
6. GSS technology provides a structure and control mechanism for meetings

Watson *et al* (1994: 105) also noted that very little is known about the effectiveness of k-GSS.

In an article by Nunamaker *et al* (1997) a number of lessons on electronic voting and polling have been compiled, which are directly relevant to any research into handset based GSS. Nunamaker *et al* (1997:185) identifies eight lessons which stem from using a GSS for electronic polling:

1. GSS polling can be used to clarify communication, focus discussion, reveal patterns of consensus or stimulate thinking.
2. Anonymous polling can bring out issues that remain buried during direct conversation.
3. GSS polling can demonstrate areas of agreement, allowing groups to close off discussion in those areas and focus only on areas of disagreement.
4. GSS polling can be used to formally register dissenting opinions.
5. GSS polling can fuse the aggregate judgement or opinions of all group members into a true group position.
6. GSS polling can facilitate closure of issues that are too painful to face using traditional methods.
7. Care must be taking to ensure that polling criteria are clearly established and defined.
8. Polling methods in decision groups need not be democratic.

2.11 Some Important Research Issues

DeSanctis and Gallupe (1987:602) suggest that, when considering GSS research, "an astounding number of issues become worthy of study". Six research directions are identified:

1. Group Support System Design
2. Patterns of Information Exchange
3. Mediating Effects of Participation
4. Effects of Perceived Physical Proximity, Interpersonal Attraction and Group Cohesion.
5. Effects on Power and Influence
6. The Performance/Satisfaction Trade-off

The research reviews summarised above and as well as others highlight the acceleration of studies in the area of GSS research (e.g. Eom, 1997; Fjermestad & Hiltz, 1999; Stevans, 1995; Cragan & White, 1990). Fjermestad & Hiltz (1999) were concerned with experimental studies carried out under 'controlled' conditions. They reported on the 'great flood' of experimental GSS research – recording over 200 related studies by

mid-1998. Earlier reviews written prior to this onslaught included far fewer experimental research, for example Benbasat & Lim, 1993 included only 31 studies in all. A number of authors acknowledge that we are still in the early days of GSS research. For example, Pervan (1998:157) argues that *“research into GSS is still in its early stages but there is worldwide interest in the area of research.”* Briggs *et al* (1998b: 4) believe that we are much nearer the beginning of GSS research than its end.

In 1997, Eom *et al* (1997:19) reported that group decision support systems were gaining acceptance only slowly. However, in a later article, Eom *et al* (1999:217) report that GSS research has been intensified over the last few years and it has now become the primary Decision Support System (DSS) research area. However, Eom *et al* (1999:217) also say that *“The inconsistent results of empirical study are an important bottleneck in generalising research findings to articulate GDSS theories.”*

An issue with much of the research conducted concerns the issue of laboratory-based research versus field studies. Dennis *et al* (1989: 305) identifies experimental research as confirmatory and field research as exploratory. However, from the summaries of experimental and field research identified earlier, there appears to be inconsistencies from the research results of laboratory experiments and field studies. Field studies have generally found improvements in group performance (in terms of decision time, decision quality, user satisfaction and participation) whereas the research within laboratory settings is far more inconsistent (Chun and Park, 1998:322).

The merits and shortfalls of both laboratory and field based investigations are well documented. The main issue concerns the need to construct the ideal research conditions. McGrath (1984) noted three factors that should be maximised in the design of studies into small group communication:

1. Generalisability (i.e. the relevance of the design to the wider population)
2. Control (i.e. the degree of precision in the process of monitoring variables)
3. Realism (i.e. the degree of realism possible during experimental research)

DeSanctis (1989: 65) identifies a number of problems of laboratory experimentation, including the high cost of such experiments, the trivial nature of many of the tasks and

the use of student groups. However, while field research may involve a higher degree of realism (e.g. employing organisational groups in situ, with actual consequences to group work) this can often compromise the extent of generalisability (i.e. eliciting outcomes that are specific to the field setting, and not representative of other groups). In contrast, lab-based research sacrifices realism (e.g. contrived groups solving hypothetical issues) whilst maintaining high generalisability (i.e. group outcomes are more likely to be ‘typical’). This view is reflected by Dennis *et al* (1989: 305) who argue that while experimental methodology provides rigor, it also lacks relevance.

O’Reilly *et al* (1987:602) argues that studies need to take account of the contextual pressures that affect decision makers’ willingness and ability to search for and use information in the actual performance of their duties. A number of studies (e.g. Beach, 1975; Ebbeson *et al*, 1975; Svenson, 1979) suggest that decisions made under the artificiality of the laboratory situations may not correspond with the same decisions made in the living world. Dennis *et al* (1989:308) argue that these differences in findings reflect different situations in organisational contexts, group characteristics, tasks and GSS environments, and therefore GSS researchers need to make explicit design decisions for each of these aspects. Chun and Park (1998:322) argue that *“the distinctive difference in the results between field and laboratory research may imply that the real effectiveness of a GDSS can only be recognised when real managers use it to tackle their live and formidable tasks”*.

Jarvenpaa *et al* (1988:646) believe that much GSS research to have limited research benefits partly because they used students who were naïve users of computers and Martz *et al* (1992:154) have also argued for greater fieldwork. Pervan (1998:157) argues that the proportion of studies where data has been collected in the field is relatively low and much fewer than laboratory experiments, and goes on to argue that *“the proportion of studies in the field is actually decreasing and the proportion of laboratory experiments is increasing. If GSS research is to maintain relevance, this trend needs to be arrested and reversed”*.

Other researchers have also called for more field study based research into the development and application of group support systems. Pinsonneault and Kraemer, (1990: 158) in calling for more field study research, accept that researchers will have

less control over contextual and independent variables than in laboratory settings, therefore they will need to identify and report the context in which the study was conducted. Eden (1992: 212) argues that if a GSS is designed specifically to address real groups working on complex issues, then to take out the characteristics that define the complexity in order to control experiments is of limited value and that “*Research with students using structured problems will say absolutely nothing about the performance of a GDSS in relation to its designed aims*” Eden (1995: 309).

Rather than using experimental approaches, Eden (1995: 310) specifically promotes the Action Research approach, where researchers work with end users in order to implement group decision support systems, as, he believes, this is the most effective way of establishing the usefulness of GSS in ‘real world’ contexts.

A further research issue is the robustness of the decision-analytic method, if used, to support the decision making process. In the GSS literature, very little attention appears to have been paid to this aspect of GSS design. Indeed, Pervan (1998) argues that:

More research needs to be done on the support of actual decision-making processes An examination of the focus of the papers on the three GSS domains, namely information technology, modelling, and behaviour, reveals that little emphasis has been placed on studying the modelling tools and processes (most studies focussing on the IT or the behaviour or both)

(Pervan, 1998:155)

The second project in this portfolio (Use of a Group Support System in Research Committees) enables analysis of the outputs of the decision making task in terms of the assumptions underlying the decision support framework adopted, and whether different possible decisions may be constructed if different assumptions are applied.

It has already been noted (in Section 2.10) that there has been limited research conducted using middle level GSS, i.e. handset based systems rather than high level computer network systems. The research presented in this portfolio discusses the development and evaluation of such a middle level system.

When used as a decision-aiding device, some form of aggregation of judgements obtained through the GSS from each of the group participants may be necessary. The ‘impossibility theorem’ of Arrow (1951) leads to the conclusion that there is no entirely fair way to form a group ranking from a set of individual rankings. The issues involved in combining rankings supplied by individuals in a committee situation have been well reviewed by others: for a survey see Vincke (1982). More recently, Chebotraev and Shamis (1998) have surveyed over 40 methods for preference aggregation. These reviews serve to highlight the variety of approaches that have been proposed, each with its strengths and weaknesses. This aspect is particularly pertinent to the second project in this portfolio (Use of a Group Support System in Research Committees).

There has been limited research concerned with how a GSS may support individual learning. An experiment using a GSS to support the teaching of nurses (Walsh *et al*, 1996) found that using a GSS resulted in greater student satisfaction and significantly higher exam scores when compared to more traditional methods, suggesting that a GSS can effectively support a learning process. Irving and Hunt (1994:458) found that the adoption of a handset based GSS improved the learning experience for student pharmacists by encouraging discussion and debate. Alavi (1994:170) found that using a GSS in a collaborative learning process enhances student learning and the evaluation of classroom experiences with MBA students. Khalifa and Kwok (1999:205) found that using a GSS can contribute to an effective learning environment, including active engagement and cooperation, where the feedback received from the other participants helps a learner to validate and reorganise his/her knowledge leading to the development of a more sophisticated knowledge structure. Leidner and Fuller (1997:159) found that when using a GSS for case study work, students show more interest in the material and perceive themselves to learn more than students that worked individually.

Nunamaker *et al* (1997: 198) believes that using a GSS in the classroom enables cooperative learning pedagogies that were not previously practical to implement but accepts that more research is required to determine how best to integrate the technology unto the physical classroom environment. Jones *et al* (2001: 585) has identified beneficial effects after introducing a handset based GSS into the learning environment, and found that the experience supports a collaborative model of learning which encourages the exchange of diverse ideas, as well as the feedback of those ideas, as

components in the effective processing of information and concepts. Gear *et al* (2003:98) have found that using handset based GSS is a practical approach to generating collective learning in organisations. There is therefore some support for the notion that using a GSS can support individual learning, and this is explored further in the third project within this portfolio (Using the Teamworker GSS to Aid Development of Professional Judgement).

2.12 Group Support Systems and Issues of Evaluation

Although there appears to be some agreement of the necessity of measuring GSS effectiveness, there is a wide range of opinions on what measures are appropriate. The necessity to evaluate a group support system will depend upon the researcher's requirements, and will differ for experimental studies and field studies. A number of evaluation measures have been used in different studies, including quality of the meeting process and the quality of the outcomes (Nunamaker, 1989); participants' satisfaction with the meeting process (Pinnsonneault and Kraemer, 1989); and communication thoroughness, for example the number of recorded thoughts (Jarvenpaa *et al*, 1988).

Eden *et al* (1992:71) identify a number of implicit and explicit evaluation criteria from the work of Watson *et al* (1988). These are:

- More democratic decision making should emerge
- The impact of group members' social approval of one another should be reduced
- Ideas should become the object of discussion rather than the proponents of the ideas
- Conflict within the group should be reduced
- Keyboard effort should not lower efficiency
- Decision quality should be improved
- Consensus among team members should be higher
- Discussion should be more substantial
- The confidence of a group in its decision should be higher
- The problem-solving process used should be transparent to the group
- There should be no increase in the social distance between participants

- The GSS should be seen as a tool not as a ‘group director’
- The group should not become overly concerned with procedural matters

In a meta-analysis of the literature, Pervan (1994: 566) identified the following measures employed in various studies: system and information quality measures (e.g. model management requirements); system use measures (e.g. the extent of system usage); user satisfaction measures (e.g. satisfaction with process, outcome or overall satisfaction); individual impact measures (e.g. decision time and consensus); and organisational impact measures (e.g. decision quality).

In laboratory experiments, an hypothesis concerning a mix of dependent and independent variables will normally be developed, and the evaluation of the GSS will depend upon whether the hypothesis can be accepted or not. The framework developed by Fjermstad and Hiltz (1999:11) contains four major categories of variables – contextual factors, intervening factors, adaption factors and outcome factors. The contextual factors are the independent variables that comprise the environment for the decision making task, and which can be manipulated for a particular experiment. The intervening factors can also affect group interaction and are often seen as moderating factors, for example session length, presence and role of a facilitator. Although often thought of as covariates, they can also be used as dependent variables in some experiments. The adaptive variables concern the interaction process of the group, e.g. amount of effort, attitude towards the GSS etc., and will be dependent on the contextual and adaptive factors applied. The outcome factors include efficiency and effectiveness measures (e.g. decision quality), and depend upon the interplay between adaptive factors, intervening factors and the contextual factors. Using such a framework, a GSS can be evaluated for particular conditions that can be controlled in the experimental situation.

Finlay (1998: 200) believes that an approach such as this would also support evaluation of field studies, where measures of success can be allied to the factors leading to the success, and refers to the frameworks proposed by Pinnsonneult and Kraemer (1989) and Finlay and Stevens (1996) as possible starting blocks. However, there are difficulties in applying such a framework in field studies. In a field study where

managers are concerned with organisational problems, it is far harder to measure many of the factors identified in such a framework, let alone control a number of specific elements. Often the evaluation will need to be context dependent and, as Eden (1996: 308) states *“may be conditioned by the research subjects who may have limited communication skills, or alternatively require VIP status treatment which prohibits the use of standard techniques that require the subject to perform operations or give responses which may seem at best mystifying or at worst humiliating”*.

Gear (1999:14) and Groves *et al* (2002) identify three main approaches for the evaluation of GSS; people centred approaches, output evaluation approaches and process centred approaches.

2.12.1 People Centred Approaches

The people centred approach will often use a post-process questionnaire and/or interviews with the participants, as the vehicle for evaluating the GSS (e.g. Hollingshead *et al*, 1993; Chidambaram, 1996). Sometimes, these questionnaire and interview approaches are applied with little reference to their development and validation. Other questionnaires have been validated against a particular framework, for example the questionnaires developed by Stevens (1995) and Davison (1997, 1999).

Reagan and Rohrburg (1990:37) have proposed four standards to assess instruments designed to evaluate group decision process effectiveness and have successfully applied these standards to a multi-criteria evaluative instrument based on the Competing Values Approach (CVA). Some of the questions in this approach seek to measure the perceptions of the participants in terms of ‘ease of use’ and ‘improvements in communication’, seen as essential ingredients of a successful support system.

Eden (1996:308) identifies deficiencies in a questionnaire approach, in terms of their ability to measure what they purport to measure, simply because of the unreliability of the respondents, and the influences of the *“phenomena of inconsistency, reduction, causal simplification, imaginative reconstruction and pure memory failure.”* Eden (1996: 308) goes on to identify in depth interviews and unsolicited comment as more

reliable method of obtaining evaluation information from management groups making use of a GSS.

A further evaluation criterion of success that is of usefulness to both designers and users of GSS is that of continued use of a GSS by an end user. As Eden (1992: 215) identifies, “*if the client group likes the GDSS, it clearly has some credibility.*” Martz *et al* (1992:154) has also considered continuing use of a GSS by an organisation under the term ‘Propensity to Use’, and identifies this as an indication of the successful implementation of a GSS and acknowledgement of the system’s value to the organisation.

2.12.2 Output Evaluation Approaches

Another type of evaluation concerns itself more with measurements of quality of output by means of ‘output evaluation’. This approach seeks to measure changes of opinion or judgement of group members as a result of the process intervention by the GSS.

Usually this type of evaluation involves laboratory-based rather than in-situ groups, working on synthesised tasks for which a ‘correct’ result is known. This allows a measure of process improvement to be constructed. A typical approach here is that of Reagan-Cirincione (1994), who identified that small interacting groups are able to perform significantly better than their most proficient members on decomposed judgement tasks when aided by an “estimate-feedback-talk” process. Unusually, the third project in this portfolio enables consideration of this output evaluation approach in a field, rather than laboratory, study. This project enables analysis of the improvement in applying a specific framework with a group of care workers.

2.12.3 Process Centred Approaches

The third approach involves a study of the detailed effects on group process that can be attributed to the presence of GSS. Interaction process and linguistic analyses have been employed by social scientists to study behaviour in groups for many years.

Developments of this type of analysis can be employed to study the modifications of process that result from the use of a GSS. Evaluation then involves an interpretation of these modifications in terms of process improvements, or otherwise. Examples of this approach include Zigurs (1989) and Hiltz *et al* (1986).

Evaluation of the group process can also be undertaken through an analysis of the data collected at sessions where a GSS has been employed. For example, Jessup *et al* (1990a) looked at the effect of anonymity using a GSS through an examination and coding of the data files produced in the group sessions. Both the second and third projects in this portfolio enable some evaluation of process through analyses of the data files produced in the group sessions.

2.12.4 Evaluating a GSS in a Field Setting

In principal one or a combination of the above methods can be employed to evaluate a given GSS in a laboratory or a field setting. However, depending on the context, some methods may not be feasible or desirable in practical terms. For example, it is unlikely that the members of some management groups concerned with real decision making tasks would be inclined to have video or audio recordings made for the post analysis of the process. There is also rarely a ‘correct result’ available with real groups and real problems, although this does happen to be the case with the third project of this portfolio.

Therefore, the methods of GSS evaluation adopted will be heavily context dependent, and will involve the aims of each specific GSS application. Finlay (1998:200) argues that GSS research should attempt to “*articulate understanding to answer the question: What is the appropriate support for a group in the context it finds itself?*”

What does seem important therefore is to define the context in which the evaluation is being undertaken, and to evaluate the support in that context using one or more of the evaluation approaches identified above.

2.13 Resume of literature review and research

In this chapter, the purpose and problems of decision making groups has been reviewed, and the role that Group Support Systems has in supporting decision-making groups has been discussed. Studies of GSS have been reviewed, and methods of evaluation of GSS have been considered.

Some important points emerge from the literature:

1. The generalisability of conclusions based on experiments with student groups in laboratory settings to applications in the field may be limited.
2. There is little research into the effectiveness (or not) of middle level, handset based GSS (k-GSS).
3. There are fundamental issues connected with the aggregation of individual judgements into some form of group result or utility function.
4. There is potential value in encouraging dialogue in a non-threatening environment within a group to assist shared understanding and learning.
5. Evaluation of a GSS in the field is complex, and likely to be context dependent.

The literature review has helped to determine the objectives of the research that has been undertaken in this portfolio of work and the methodology used to achieve these objectives. In particular, the research is focussed on the development of a specific type of GSS known as Teamworker, using handset based technology, the application of this GSS in a number of organisational (and not laboratory) contexts, the evaluation of the GSS in two specific contexts, and the determination of GSS frameworks and design guidelines that can help in understanding the important issues involved when designing and implementing a new GSS application, using Teamworker type technology, in an organisational context.

3 Research Methodology and Research Framework for GSS Evaluation

This portfolio of work considers three different, but related, projects. Each of the projects is concerned with the development, application and evaluation of a specific type of Group Support System (GSS). Each of the projects has been undertaken over a different period of time. The research methodology that has been adopted is therefore more complex and multi-faceted than might be normally considered appropriate for a normal PhD, as each of the projects has been conducted using a methodology that was appropriate for that particular project.

The primary research aims concern the development and application of a new Group Support System and an approach that will support the evaluation of a Group Support System in a field setting. This approach has been developed through the development of a new GSS and its application in a number of different field settings (Project One). Projects Two and Three are concerned with evaluating the GSS in specific field settings. The research concerns the use of a type of information system (the Group Support System) by organisations, and therefore the approach to this research is influenced both by previous management and social science research and information systems research.

This section identifies the research philosophy that underpins the research and also discusses the research strategy and research methodologies that have been used to carry out this research

3.1 Research Philosophy

The research method(s) used to collect, analyse and use data about some phenomenon will be determined by the underlying philosophical position of the researcher. Easterby-Smith *et al* (1994:27) believes that there are three reasons why an understanding of philosophical issues is useful in management research:

1. It can help clarify research designs
2. It can help the researcher recognise which designs will work and which will not
3. It can help identify and create designs that may be outside the researchers experience

The philosophical view that underlies a particular research approach is determined by epistemology (beliefs about the nature of knowledge) that underlies a particular philosophical view. Two major contrasting views of how research should be conducted are the positivist approach, also known as scientific method, and the interpretivist approach.

3.1.1 Positivism

This is an approach to research that is based on a belief that the world is external and objective, and can therefore be measured (Remenyi *et al*, 1998:104). Within a social science context, this implies that the researcher is working with a concrete and observable social reality, and that the research will lead to the derivation of law like generalisations similar to those produced by natural scientists, normally through quantifiable observations that can be analysed statistically. Positivists follow the natural science approach in which theories and hypotheses can be tested and either verified or falsified. It is also assumed that the researcher can be independent of and neither affects nor is affected by the subject of the research. The positivist epistemology is therefore concerned only with observable phenomena and the testing of theories in a hypothetical-deductive fashion (Gill and Johnson, 1997:139) and on the existence of a priori fixed relationships within phenomena.

To be able to observe a phenomenon directly and objectively, the researcher must not be able to affect the object being studied. The researcher must also be neutral – that is that researchers cannot adopt a moral or political stance. Predictions can then be made on the basis of the observed and explained realities and their interrelationships.

3.1.2 Interpretivism

Interpretivists argue that the subjective interpretation of reality is necessary in order to fully understand that reality. Interpretive studies assume that people create and associate their own subjective meanings as they interact with the world around them, and reject the possibility of an objective or factual account of events and situations. Generalisation from the setting to a population is not sought, but rather an understanding of the deeper structure of a phenomenon, which it is believed can then be used to inform other settings.

3.1.3 Discussion and Research Approach

Both the positivist and interpretivist paradigms have a long history. Both can be shown to start in the Classical Greek period with Plato and Aristotle following the positivist paradigm and the Sophists (anti-positivists) following the interpretivist paradigm. Well known positivists include Descartes, Bacon, Newton, Mill, Spencer, and Durkheim. Well known interpretivists include Kant, Hegel, Marx, Weber, Mead, Bretano and Hisserl (Hirschheim, 1985:20; Davison, 1998).

It would appear that the positivist approach has had a greater influence on information systems research, at least over the last 25 years. In a study of 155 information systems articles, Orlikowski and Baroudi (1991:6) found that almost 97% followed the positivist tradition. In a separate review of 902 information systems articles, Alavi and Carlson (1992:56) found that all of the 437 empirical articles identified in the review followed a positivist orientation. Pervan (1998:150), when reviewing 131 Group Support Systems articles, found that, for empirical GSS studies, most followed the positivist approach. Galliers and Land (1987:900), when reviewing information systems research, also identify the primacy of traditional, empirical research more suited to the natural sciences.

However, a number of writers (e.g. Galliers and Land, 1987; Remenyi and Williams, 1996; Kaplan and Duchon, 1988) argue that information systems is a very broad category of study that can include the interaction of people with technology, and that will therefore include many disciplines in the social sciences, management and

organisations. There has been much debate on whether the positivist approach alone is entirely valid for management research (e.g. Easterby-Smith et al, 1994; Fielding and Fielding, 1986; Hirschheim, 1985; Gill and Johnson, 1997). Weaknesses of the positivist approach when studying management and organisational processes include ecological validity, volunteer characteristics, and experimenter effects on subjects. Kaplan and Duchon (1988:572) for example, argue that the study of social systems “involves so many uncontrolled – and unidentified – variables, methods for studying closed systems do not apply as well in natural settings as in controlled ones”. They argue that by simplifying the situation to enable good experimental design, only obvious results are possible. Susman and Evered (1978: 583) have also identified a number of deficiencies of the positivist approach for generating knowledge for use in solving problems that members of organisations use.

Because of these weaknesses many writers have suggested that a more varied approach should be taken towards information systems research (e.g. Remenyi and Williams, 1996; Galliers and Land,; Kaplan and Duchon, 1988; Alavi and Carlson, 1992) and have argued for a greater amount of research that follows the interpretivist paradigm. For example, Alavi and Carlson (1992) argue that:

Complementing the dominant positivist MIS research paradigm with alternative perspectives and philosophical bases is important to further development of the field. Progress in the field can be enhanced by adopting a plurality of research perspectives to gain insights into complex MIS phenomena

(Alavi and Carlson, 1992: 57)

A number of writers argue that no single research methodology can be said to be intrinsically superior to any other methodology (e.g. Benbasat et al, 1987; Dennis et al, 1989; Remenyi et al, 1998; Gill and Johnson, 1997). Rather, a research methodology should be chosen that is best suited to the problem under consideration and the objectives of the researcher (e.g. Benbasat, 1984:78; Galliers, 1992:161).

The overall research philosophy adopted for this research is based upon the interpretivist philosophy. A major concern of the research presented in this portfolio is that the methods chosen should be relevant to the research objectives set out for each of

the projects, and should also be rigorous in terms of their implementation. In this research I have tried to avoid insisting on the use of a single research method to the exclusion of all other methods, as I believe that all research methods may be valuable if used appropriately, and that research can include elements of both the interpretivist paradigm and the positivist paradigm if carefully managed.

The research aims identified in the Overview and for each project are concerned with the development, application and evaluation of a Group Support System with organisational groups and tasks. The Group Support System has been developed over time on the basis of implementing the system with organisational groups and obtaining feedback on the usefulness of the system. Each implementation of the system has involved the use of a GSS by the group for a first time. Therefore I have had to intervene with the groups to enable the system to be developed and implemented – this just could not occur without my involvement with the groups, to enable the system to be developed to meet the group's requirements. However, understanding the lack of objectivity that can be associated with interpretivist approaches, a positivist stance has been used to analyse some of the data that has been generated.

3.2 *Review of Research Strategies*

There are a large number of methods that have been identified for information systems research. Benbasat (1984:53) identified only five empirical research strategies, however Alavi and Carlson (1992:48) identified 17 different research strategies in an analysis of 908 MIS research from 1968 to 1988. Galliers (1992:149) has identified 14 different research methods in his revised taxonomy of information systems research approaches, as shown in Table 2.

| Scientific/Positivist | Interpretivist |
|------------------------------|--------------------------|
| Laboratory experiments | Subjective/argumentative |
| Field experiments | Reviews |
| Surveys | Action research |
| Case studies | Case studies |
| Theorem proof | Descriptive/interpretive |
| Forecasting/Futures Research | Futures research |
| Simulation | Role/game playing |

Table 2: Information Systems Research Approaches (Galliers, 1992:159)

Note that in Table 2, Case Studies appear under both the positivist and interpretivist approaches. Galliers (1992:154) originally placed case studies into the positivist tradition, but recognised that many writers include the Case Study method under the interpretivist tradition. There follows a brief analysis of the strengths and weaknesses of each of the methods shown in Table 2.

3.2.1 Laboratory Experiments

Laboratory experiments allow the researcher to identify precise relationships between a number of variables through a designed laboratory controlled environment and using quantitative analytical techniques, with the objective of making generalisable statements that are applicable to real-life situations. The strength of this method is the ability to control a small number of variables that can be studied intensively. A key weakness is *“the limited extent to which identified relationships exist in the real world due to oversimplification of the experimental situation and the isolation of such situations from most of the variables that are found in the real world”* (Galliers, 1992:150).

3.2.2 Field Experiments

These are an extension of laboratory experiments into real-life situations and real organisations. The key advantage is the greater realism that such experiments provide when compared with laboratory settings. However it is often difficult finding

organisations that are prepared to be experimented on, and it is also difficult to achieve sufficient control to enable replication of the experiments.

3.2.3 Surveys

Using survey questionnaires and interviews, the researcher can obtain a snap shot of practices, situations or views at one point in time. Quantitative analytical techniques can then be used to draw inferences from this data concerning the relationships that exist. An advantage of this method is that a greater number of variables may be studied than in the case of experimental approaches and data can be collected about real world situations. However it is difficult to realise insights regarding the causes and processes behind the phenomena being studied. There is also the possibility of biases by the respondents (particularly with self selecting questionnaire respondents). The moment in time when the survey is conducted and the possible bias of the researcher are also concerns with this method.

3.2.4 Case Studies

Case studies attempt to describe relationships that exist in real world situations, often in a single organisation and may be based on either an interpretivist or positivist approach. Reality can be captured in greater detail and more variables can be analysed than in the experimental approaches identified earlier. However, there is often the disadvantage that a case study is restricted to a single event or organisation, and it is difficult to generalise the findings as it is difficult to find similar data from a statistically meaningful number of cases. There is also a lack of control on the variables under study. Lastly, there may be different interpretations of the same data by different researchers as a result of researcher bias.

3.2.5 Theorem Proof

This is concerned with the development and testing of theorems in relation to information systems development and implementation, and is closely linked to the scientific method and positivist paradigm. However, this method is generally more applicable at the technical end of the socio-technical spectrum, and becomes less

applicable as the researcher moves towards the social pole of the socio-technical spectrum.

3.2.6 Forecasting/Futures Research

This research method involves the use of techniques such as regression analysis and time series analysis to predict/extrapolate likely events in the future. Other techniques that are relevant here include the Delphi technique and change analysis. These techniques are useful for providing some insight into the impact of information technology on individuals, organisations and society. However, there are many difficulties dealing with the complexities and changing relationships of the variables under study, and the lack of knowledge about the future. These techniques are often dependent on the precision and relevance of past data and the expertise of scenario builders.

3.2.7 Simulation/Game and Role Playing

These techniques attempt to model the behaviour of a system using random variables that might otherwise be difficult or impossible to solve analytically. Although these techniques provide an opportunity to study situations that might be impossible to analyse using other methods, there are often problems in devising simulations that accurately reflect real world situations.

3.2.8 Subjective/Argumentative Research

This is a creative research strategy that is contained within the interpretivist paradigm, and is based upon opinion and speculation of the researcher rather than observation. There is a large emphasis on the role and perspective of the researcher, and the method requires the researcher to adopt or create a speculative view of the issue under study. There is recognition that the researcher will interpret what is being studied, and this method allows new ideas to be generated and new theories to be built that may be subsequently tested using more formal methods. However it may be criticised as an unstructured, subjective research process.

3.2.9 Action Research

Action research involves the researcher becoming directly involved in an intervention in an organisation that leads to change, often in partnership with those who will be affected by the change. The outcome should lead to practical benefits for the organisation while at the same time adding to theoretical knowledge. Weakness of this approach are similar to those identified for case studies, in that the application of this method will often be limited to a single organisation and generalisation of results to other situations is difficult. The ethical position of the researcher is also important, as the researcher is given the opportunity to directly intervene in an organisational issue.

3.2.10 Descriptive/Interpretive Research and Reviews

This method is closely allied to the phenomenological school of thought. This school of thought focuses on an analytical description of the phenomena under study not affected by any prior assumptions. There is great variety in the phenomenological movement, and this type of research can be focussed on the literature and past developments as well as current events. Advances in knowledge and theory can be made through an in-depth review of previous research on a specific subject matter. However, problems may arise when the researcher must interpret the results of research with which they may not be familiar.

3.3 Research Strategies Used For This Research

Having briefly reviewed various research strategies, the primary strategies used in this portfolio will now be discussed in more detail. As already identified, the overall research philosophy adopted for this research is based upon the interpretivist approach. The aims of developing a new Group Support System, and applying and evaluating the GSS in real life situations, thus developing theory on the usefulness on this type of GSS, has led me to select Action Research as the primary research strategy. However, elements of case study research have also been used, as each of the applications of the GSS can be considered to be a case study in its own right.

3.3.1 Action Research/Action Science

To maintain objectivity, conventional laboratory-derived research methods that follow the positivist paradigm seek to minimise the degree of interaction between the researcher and the subjects that are the basis of the research. In contrast, action research involves the researcher becoming directly involved in any intervention in an organisation that leads to change, often in partnership with those who will be affected by the change. The effects of this intervention are then monitored and evaluated to identify whether or not that action has produced the expected consequences. The origins of Action Research are usually accredited with Kurt Lewin, who coined the term in 1944 (e.g. Lewin, 1946; Peters and Robinson, 1984:114). Lewin saw Action Research as a way of learning about a social system and simultaneously trying to change it. A number of definitions of Action Research can be identified, for example Remenyi *et al* (1998:49) identify Action Research as involving a small-scale intervention on the part of the researcher in the phenomenon being studied. Rapaport (1970) gives the following definition:

Action Research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework

(Rapaport, 1970:499)

With action research, the action researcher is actively involved in a problem situation where both the researcher and the client organisation should obtain benefits (Avison *et al*, 1999; Baskerville and Wood-Harper, 1996:238; Baskerville, 1999; Rapoport, 1970:499). Action research is particularly suited to problems where theory has been generated by previous research and which can then be tested ‘in the field’.

Contributions to both theory and practice should then result (Checkland, 1991:401; Eden and Huxham, 1996:80). Bell (1999:10) identifies action research as an approach, not a particular technique or methodology. However, other researchers also see action research as a sub-class of methods (Baskerville, 1999).

A number of social scientists have expressed support for this particular research approach. For example, Susman and Evered (1978:595) legitimate the scientific merits

of action research by locating its foundation in philosophical viewpoints, such as phenomenology, which differ from those used to legitimate positivist science. Argyris and Schon (1989:613) suggest that the term 'Action Science' should be used to distinguish academic research and theory testing from problem solving and consultancy. This view is shared by Gummesson (2000:119) who identifies ten points that specify his concept of Management Action Science. These are:

1. Action scientists take action
2. Action science has dual goals: both to contribute to the client and to contribute to science
3. Action science is interactive; it requires co-operation between researchers and client personnel and continuous adjustment to new information and new events
4. The understanding developed during an action science project aims at being holistic, recognising complexities
5. Action science is applicable to the understanding, planning, and implementation of change in business firms and other organisations
6. It is essential to understand the ethical framework and the values and norms within which action science is used in a particular project
7. Action science can include all types of data-generating methods but requires the total involvement of the researcher
8. Constructively applied pre-understanding of the corporate environment and the conditions of business is essential
9. Management action science should preferably be conducted in real time, but retrospective action science is also an option
10. The management action science paradigm requires its own quality criteria. It cannot be evaluated solely by the criteria emanating from the scientific paradigm – equal consideration must be given to the practical consequences for the client organisation

Action research enables a researcher to work on real life problems within an organisation enabling research to be undertaken in complex organisational situations, where benefits can accrue for both the researcher and the organisation. Gaining access to organisations and their problems is often difficult for the academic researcher, and action research is one way in which this access can be obtained. Even so, other issues

must be considered, including ethical issues (for example, the organisation may insist on a ‘successful’ outcome, where the organisation may determine what success means). The researcher must also ensure that action research is undertaken rigorously; as Eden (1995:310) says, “*action research can often be used as a label to excuse sloppy research which is written up as an afterthought.*” Nevertheless, as Checkland (1981:153) comments, action research studies should not and cannot be wholly planned and directed down particular paths.

Much published action research arises in applied health fields and management research (Baskerville and Wood-Harper, 1996:237; Eden and Huxham, 1996:75), and can also be found in literature on social and community action, organisational development and the transformation of educational organisations and practices (Peters and Robinson, 1984: 116).

Checkland (1981) makes extensive use of action research in the methodology of systems development, through the development and application of Soft Systems Methodology (SSM). Other studies that concern the application of Information Systems in general and GSS in particular have also used the action research approach. Lau (1997:37) has identified 30 IS studies reported in the literature which used action research as the primary research approach over a 25 year period. Baskerville and Wood-Harper (1996:244) acknowledge that the action research approach could appropriately assume a growing role in mainstream IS research and practice. Davison (2001) used action research approach in his study of the use of a GSS with the Hong Kong police force, and Olesen and Myers (1999) used action research methodology to improve communication and collaboration in an organisation through the implementation of a groupware product.

Action researchers will directly participate or intervene in a situation in order to apply a theory and evaluate the usefulness of that theory (Argyris and Schon, 1989:613; Baskerville and Wood-Harper, 1996:238; Elden and Chisholm, 1993:129). Action research can therefore be used both for theory testing and for theory building (Galliers, 1992:159). Eden and Huxham (1996) emphasise that:

Action research should have some implications beyond those required for action or generation of knowledge in the domain of the project.....it must be clear that the results could inform other contexts, at least in the sense of suggesting areas for consideration

(Eden and Huxham, 1996:78)

Baskerville and Wood-Harper (1996:244) note that a number of problems confront researchers using the action research approach. These include the lack of impartiality, lack of discipline, confusion with consulting and its context-bound nature. However, it is also noted that these problems may also confront researchers using alternative methods of research. To obtain scientific rigour, Baskerville and Wood-Harper (1996:244) suggest that:

- An ethical client-system infrastructure should be established
- Data collection must be planned carefully
- Action researchers should observe iterative phases that formulate theory, plan action, take action and evaluate the action
- Generalisations based on theory and learning may be implied from the research
- Reports of the research must disseminate the scientific knowledge achieved by the study to allow future work that can confirm or refute any causal suggestions or claims of generalised theory

Action research is often seen as an iterative process. For example, Susman and Evered (1978:588) identify an action research model involving a cyclical process with five phases:

1. Diagnosing – identifying or defining a problem, and helping the organisational participants to understand the problem.
2. Action planning – considering alternative courses of action for solving the problem that has been diagnosed
3. Action taking – selecting and implementing a particular course of action to solve the problem
4. Evaluating – studying the consequences of the course of action selected

5. Specifying Learning – identifying general findings on the basis of the evaluation

In undertaking action research, the researcher should be aware of the effect that his or her presence has on the situation (Remenyi *et al*, 1998:50). Additionally, the researcher should also be aware of the values, beliefs and intentions of the participants in order to understand what constitutes ‘social reality’ in the problem situation (Peters and Robinson, 1984:122). The ethics of the research should also be an important consideration, as the researcher might become aligned with a particular grouping whose objectives are at odds with other groupings (Galliers, 1992:158).

3.3.2 Case Study Research

There is therefore no one overarching definition of case study research, and the term ‘case study’ is used for a variety of research approaches, both quantitative and qualitative (Holloway, 1997:30). Stake (1995:2) observed “*we cannot make precise definitions of cases or case studies because practices already exist for case study in many disciplines*”, for example, medicine, business, law and anthropology which all take slightly different views. One definition of a case study is given by (Benbasat *et al*, 1987):

A case study examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or more entities (people, groups, or organisations). The boundaries of the phenomenon are not clearly evident at the outset of the research and no experimental control or manipulation is used

(Benbasat *et al*, 1987:370)

Benbasat *et al* (1987:371) also identifies eleven characteristics of case studies. These are:

1. Phenomenon is examined in a natural setting
2. Data are collected by multiple means
3. One or few entities (person, group, or organisation) are examined
4. The complexity of the unit is studied intensively

5. Case studies are more suitable for the exploration, classification and hypothesis development stages of the knowledge building process – i.e. theory building
6. No experimental controls or manipulation are involved
7. The researcher may not specify the set of independent and dependent variables in advance
8. The results derived depend heavily on the integrative powers of the researcher
9. Changes in site selection and data collection methods could take place as the researcher develops new hypotheses
10. Case research is useful in the study of “why” and “how” questions because these deal with operational links to be traced over time rather than with frequency or incidence
11. The focus is on contemporary events

Benbasat *et al* (1987:370) also identify three reasons that make case study a viable research method. These are:

1. The researcher can study an issue in a natural setting, learn about the state of art and generate theories from practice
2. The case method allows the researcher to answer “how” and “why” questions, so as to understand the nature and complexity of the processes taking place
3. A case approach is an appropriate way to research an area in which few previous studies have taken place, especially in the information systems subject area where there is a rapid pace of change

According to Gummesson (2000:87), case study research has been receiving growing attention among management researchers. However, there is the question of how many cases should be analysed. Remenyi *et al* (1998:181) gives no hard and fast conclusion on the number of cases that should be considered to allow generalisations to be made – sometimes one case is sufficient, other times multiple cases may be necessary.

Gummesson (2000) believes that

It is no longer seems so 'obvious' that a limited number of cases cannot be used as a basis for generalisation. Nor is it obvious that properly devised statistical

studies based on large numbers of observations will lead to meaningful conclusions

(Gummesson, 2000:88)

Single cases may be adequate for exploratory studies where there is no previous theory, or when testing an existing well-known theory. Multiple cases may be preferable when the research is designed to develop and test theories, and also permit cross-case analysis that can support generalisation (Benbasat *et al*, 1987:373).

Case studies can contribute in important ways to our knowledge, and enable a more holistic perspective to be adopted by the researcher than might be achieved with other methods. To ensure construct validity as far as possible, multiple data collection methods are required. Yin (1994:80) identifies the following six methods:

1. Documentation, for example printed and electronic information about the organisation, including newspaper articles
2. Archival records, such as personal and service records
3. Interviews – structured or unstructured
4. Direct observation of activities and the phenomena under investigation
5. Participant-observation, where the observer can also participate in the events
6. Physical and cultural artefacts produced by the phenomenon

Each of the above methods, other than the production of archival records, is used to some extent in one or more of the different cases considered in this portfolio.

3.3.3 A Combined Case Study and Action Research Approach

In a review of case study literature (Benbasat *et al*, 1987:371), action research was identified as one of three categories of qualitative study that appeared to be considered as case study research. Galliers (1992:47) also identifies action research to be compatible with case study research. Gummesson (2000:116) identifies action research as “*the most demanding and far-reaching method of doing case study research*”.

Action research attempts to optimise the realisation of both the practical affairs of man and the intellectual interest of the scientific community (Rapaport, 1970:510). To do this, the action researcher will participate or intervene in a problem situation in some way, although the extent of this intervention will be varied depending upon the context of the problem situation and the researcher. Involvement of the participants in any particular piece of research can also vary.

Davison (1998) argues that the three reasons identified by Benbasat *et al* (1987:370) above that make case study a viable research method are also true for action research, a view I support. Therefore this portfolio uses action research to enable the Group Support System to be developed and implemented in a number of different organisations, and case study methods to enable evaluation of the implementation. Such a combined approach has previously been used by Davison (1998) to investigate the implementation of a GSS in organisations in Hong Kong.

The issues that are being investigated involving organisational groups concerned with discussion based and decision-making tasks where there may be many individual concerns and agendas, are too complex to be measured in an experimental setting – either in the laboratory or in the field. Complexities include organisational politics and culture, and interpersonal relationships between the different members of any one group. Each of reasons for undertaking case study research identified by Benbasat *et al* (1987:370) is relevant here:

- I believe that the use of a Group Support System within organisations must be conducted in a natural setting. An unnatural setting (e.g. laboratory setting or contrived tasks) would not allow the complexities of dealing with real groups to be analysed. This point is also supported by Galliers (1992:150).
- I am interested in the “how” and “why” a Group Support System might be used within an organisation setting, to improve the usefulness of Group Support Systems in an organisational context.

- Although there has been a great deal of research on the effectiveness of Group Support Systems, these are generally restricted to a certain classes of GSS (i.e. networked personal computer systems and facilitator led single personal computer systems). The GSS I have developed is of a different nature, where there has been limited published research.

3.4 *Issues of Objectivity, Validity and Ethics*

The case study approach is a way of exploring a phenomenon in its context. However, without an action research approach, it is unlikely that any of the organisations included in this portfolio would have accepted the implementation and use of a GSS to help support their group tasks.

In each of the groups I have worked with, I have not been a participant. I have adjusted the use and application of the technology to meet the needs of the group without becoming one of the group. However, it must be accepted that subjective elements and biases are likely to be introduced when designing and applying a GSS, particularly when interpreting user requirements and understanding the nature of the task, framing the problem, selecting the decision analytic model and formulating the final design of the GSS. However, the applications discussed in this thesis would not have been achieved without my participation, thereby foregoing valuable research information on the effectiveness of GSS in field settings. The use of field settings in this portfolio has resulted in greater ecological validity than would be achieved in the artificiality of the laboratory where tasks and participants are convened in the absence of an organisational context.

Nevertheless, despite my participation in designing the GSS for the situations discussed in this portfolio, I have not been directly involved in directing the use of the GSS with organisational groups, nor in any other aspect of directly influencing the group process (e.g. through facilitating the group process). This role has been undertaken by employees or other agents of the organisation involved. My role within the group process has been either to act as the operator of the GSS, responding to the requests of the group or facilitator to make available the facilities provided by the GSS, or to take no part at all.

It should be recognised in this portfolio that I am supportive of using a GSS to aid certain group processes, and this bias may be reflected in the selection of the analyses undertaken which inevitably reflect the interests of the researcher. However the data captured through using the GSS, and not my personal views, has driven the analysis and conclusions, and I have aimed to be impartial in reporting these analyses. The Research Framework for GSS Evaluation has also helped to maintain a degree of objectivity and focus to system evaluation in the field.

Validity is concerned with establishing the authenticity of the research undertaken. Internal validity is concerned with demonstrating that there is valid evidence for the findings of a piece of research (e.g. Robson, 1993: 46). Internal validity may be demonstrated through a coherent storyline and sound argument consistent with the evidence that supports it (e.g. Holloway, 1997:159; Remenyi *et al*, 1998: 180). Also using multiple methods of data collection and evidence from different sources of data can support internal validity. I have used different sources of data (e.g. data collected through use of the Teamworker handsets, interviews, information from publicly available materials such as newspapers and magazines, observation of the group process). I believe that my conclusions are consistent with analyses of this data, much of which has been obtained from repeated meetings in similar contexts (in Projects Two and Three).

Generalisation (or external validity) is often difficult to achieve with qualitative research as results may be context specific. There is also debate as to how many cases are required to enable generalisations to be made. Gummesson (2000: 96) has introduced the concept of '*saturation*', which is the diminishing marginal contribution of each additional case. When this marginal contribution approaches zero, there is no need for additional cases. Where possible, generalisations have been identified in the conclusions of this portfolio, based upon the data available and analysed in the eleven cases considered in total. Care has also been taken in describing each of the cases, to enable others to consider the transferability of findings to other situations, as researchers or practitioners.

I believe ethical practice is fundamental to good research practice. Consequently, when designing and carrying out any research ethics must be taken into consideration. Gill and Johnson (1997) identify confidentiality and protection of participants as important ethical issues in Action Research.

Ethical issues have been taken into consideration throughout the research in this portfolio. All of the quotes used from individuals are either in the public domain already or the individuals concerned have given permission for these quotes to be publicly used. The organisations identified in the case studies have given permission to be named in the applications that have been referred to, except for two organisations, one of which that has simply been referred to as a US based multinational oil corporation and the other as a public-sector Research Award Body. Data collected and presented has been anonymised where necessary to ensure that specific information cannot be linked to any organisation or individual.

3.5 A Research Framework for GSS Evaluation

A research framework can help focus research and avoid dissipation of the research effort (Stevens and Finlay, 1996: 221). A number of research frameworks for GSS application and use have been identified in the literature review (e.g. Nunamaker *et al*, 1991; Pinsonneault and Kraemer, 1991; Fjemstad and Hiltz, 1999, Stevens and Finlay, 1996). There appears to be a broad consistency across many of these frameworks. Most frameworks appear to follow an Input-Process-Outcome (IPO) approach which enable factors to be classified as either Input Factors, Process Factors and Outcome Factors. Many of these factors also seem to be common across the frameworks. For example common input factors include the group and its structure, personal characteristics of individuals in the group, the group task, and the situation in which the task is occurring. The group process is considered as the interaction of the group members, and the outputs include the effects of the process on the individual, the group, and task related outcomes.

Many of these frameworks are used as contextual descriptions of situations where GSS has been applied, and there appears to be an emphasis on identifying all of the major factors that can help describe the context and the outcomes. For example, Stevens and

Finlay (1996) identify 90 factors that include group and organisational characteristics. However the measurement of a large number of factors in a field setting is not a trivial task.

The literature review also identifies aspects of GSS evaluation, and in particular identifies three evaluation approaches (Gear, 1999; Groves *et al*, 2002) that are intended to be complementary:

1. People Centred Approaches
2. Output Evaluation Approaches
3. Process Centred Approaches

Ideally, evaluation should involve an investigation of all of these aspects. However, evaluation of a GSS in a field setting, where groups are working on organisational tasks, may mean that not all of these three approaches may be feasible for task related and/or political reasons. Measuring group process (for example through recording and analysis of dialogue) is difficult to do in an organisational setting, but may be undertaken with the consent of the organisation and the group participants. It can also be difficult to measure some of the context, group, and task variables identified in research frameworks found in the literature in a field setting (e.g. group cohesiveness, group members decision-making style).

The Research Framework for GSS Evaluation adopted for the research discussed in this portfolio is shown in Figure 4. The framework shows an Input-Process-Outcome model, but with a concentration on:

- The identification of the context, group and task characteristics.
- The identification of the important GSS design elements.
- The group process variables that can be measured in the case studies analysed in Projects Two and Three.
- The outcome variables that can be measured in the case studies analysed in Projects Two and Three.
- The three evaluation approaches considered important in this research.

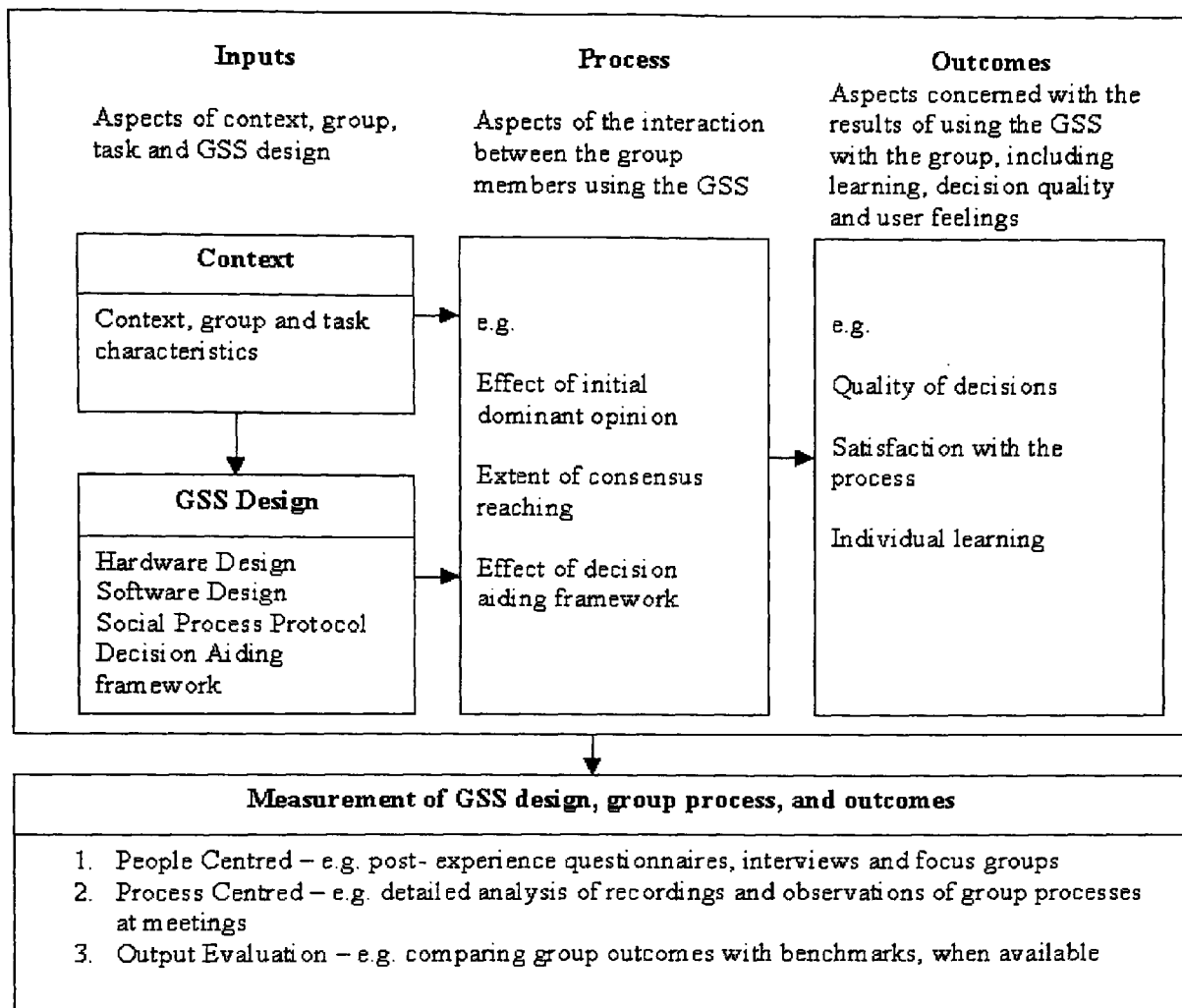


Figure 4: Research Framework for GSS Evaluation

The Research Framework includes the elements of GSS Design, which is an important consideration throughout this portfolio. This aspect is considered further in Project One, where an output of this project is a GSS Design Framework that can be used to support the design of a GSS in a specific context. The other input aspect included in this Research Framework is Context, which, as identified earlier, is common across many other similar frameworks. There are a number of group process variables that may affect the use of the GSS and may also be influenced by the particular GSS. The three group process variables shown in Figure 4 are three specific variables that can be evaluated through the field experiments analysed in Projects 2 and 3. It is possible that further field experiments could usefully consider other group process variables, for

example efficiency of communication, participation and levels of task-orientated communication (e.g. Pinnoseault and Kraemar; 1989:199)

Outcomes will be dependent on the objectives of the group session, as well as the GSS design characteristics and the group process. The outcomes that can be measured in the field studies analysed in Projects Two and Three are Decision Quality, Individual Learning, and Satisfaction with the Process. It is possible that further field experiments could consider other outcome variables, for example commitment of group members to decision and confidence of group members with the decision (e.g. Pinnoseault and Kraemar; 1989:199)

3.6 Operational Design

The research methods used in the portfolio are a combination of action research and case study research. However, each of the three projects within this portfolio are ‘self standing’, and have been undertaken with different research objectives. Therefore the ‘operationalisation’ of the research approach is necessarily different for each project.

3.6.1 Project One – Development and Applications of the Teamworker Group Support System

The objectives of this project are to develop a novel Group Support System, and to demonstrate its usefulness through a number of real life applications in a number of different contexts, reported using a ‘mini case study vignette’ approach. The development of the Teamworker GSS is more than a straightforward engineering project. The Teamworker GSS has been developed on the basis of the academic literature on group problems and the usefulness of developing additional communication facilities within groups using information technology. The Teamworker GSS is novel, however, as it uses radio handset technology within management groups to support the group process and has been designed to enable a number of decision modelling techniques and social protocols to be implemented in different contexts. The Teamworker GSS is different from most developed GSS used within organisations, in that it is neither based upon a PC network nor on a facilitator

led PC system using a particular decision-analytic model and social protocol. There is also a lack of published academic literature on the application of GSS similar to Teamworker, other than that which I have been involved with.

The methods suggested by Yin (1994:78) to demonstrate validity using a case study approach, i.e.

1. Direct observation of activities and the phenomena under investigation
2. Indirect observation or measurement of process related phenomena
3. Interviews – structured or unstructured
4. Documentation, for example printed and electronic information about the organisation, including newspaper articles
5. Information about previous use of the technology relevant to the case

have been used throughout the mini case study vignettes.

Each of the nine applications described using the mini case study vignettes has been developed through an action research approach, as suggested by Susman and Evered (1978). Additionally, this project also includes the Teamworker GSS, including the radio handset technology developed and the software developed for each application identified.

The outputs from this project are the completed Teamworker GSS (hardware and software), and the mini case study vignettes that identify the usefulness of the Teamworker GSS in a variety of contexts.

3.6.2 Project Two - Use of a Group Support System in Research Committees.

This project is based upon the data collected from peer group research committees that form part of a public-sector Research Award Body over a four-year period. The peer group committees were used to rank research proposals from universities and other establishments to enable funding decisions to be made. The data was collected using Teamworker, and this data has been analysed to consider the sensitivity of the rankings

produced (and therefore the funding decisions made) over a number of years. These analyses help determine the effectiveness of the process used in each of the committee meetings. Some of the issues arising from this project have been reported in Read *et al* (2000a).

An action research approach was used to introduce and implement the Teamworker GSS with the Award Body. Each of the action research phases identified by Susman and Evered (1978) have been followed:

1. Diagnosing – identifying or defining a problem, and helping the organisational participants to understand the problem.

The problem identified by the Award Body was that a number of large number of proposals for research council had to be considered by a peer review committee in a short period of time (typically one or two days). Only a small minority of proposals could be funded by the research council. The Head of the Science Division required a method whereby as much time as possible could be concentrated on those proposals considered ‘marginal’ for funding.

2. Action planning – considering alternative courses of action for solving the problem that has been diagnosed

The research council had already considered various courses of action. However, in discussions between the Head of the Science Division and ourselves, it was decided to pilot the use of the Teamworker GSS to rank the proposals and identify a marginal (or grey’ list).

3. Action taking – selecting and implementing a particular course of action to solve the problem

This course of action was tested through a number of demonstrations with Award Body personnel and peer committee review chairman and members. Having gained understanding of the task and situation characteristics, a decision-aiding framework, process framework and social process protocol was determined through the joint

collaboration of Award Body personnel, Professor Gear and myself. Only when these issues had been established was appropriate software designed to meet the requirements.

4. Evaluating – studying the consequences of the course of action selected

The Teamworker GSS was piloted for a set of Award Body review committees. The Head of Science Division then obtained feedback from committee members and Award Body personnel on the perceived usefulness and effectiveness of the Teamworker GSS. The result of the evaluation process was that the Teamworker GSS was regularly used for the following five years in the peer committee review meetings, until finally the Award Body was disbanded.

5. Specifying Learning – identifying general findings on the basis of the evaluation

The data collected for the final four years of use has enabled a number of hypotheses about the process to be tested. In particular, concerns over the process and the decision-aiding framework have been identified, and these concerns feed into the GSS design guidelines specified in this Overview.

The project is reported using a case study methodology, so again data has been obtained and used from a number of sources, including personal reflections, conversations with participants, newspaper and journal articles, and the data collected through using the Teamworker GSS.

3.6.3 Project Three – Using a Group Support System to Aid Development of Professional Judgement

Teamworker is used to support groups of professionals undergoing professional development and training for the effective implementation of an approach to the gathering and subsequent utilisation of information relating to recipients of nursing, rehabilitation and other care services in Norway through the assessment of a number of 17 variables; this approach is known as Gerix and it has been adopted by the Norwegian Department of Social Security. The training of groups in using Gerix has been contracted to a private company, known as TeamStandards. Participants consider

‘standard’ cases for which the correct assessments are known, but not by members of the group. The availability of this data allows measurement of the efficacy of this approach to professional development. Some issues from this particular application are also reported in Read *et al* (1998) and Read *et al* (2003).

An action research approach was used to introduce and implement the Teamworker GSS with the training groups. Each of the action research phases identified by Susman and Evered (1978) have been followed:

1. Diagnosing – identifying or defining a problem, and helping the organisational participants to understand the problem.

The problem identified by the TeamStandards was that many hundreds of care worker professionals (social workers, nurses, doctors etc) had to be trained to consistently use their professional judgement to apply a newly devised approach, known as Gerix, for the gathering and subsequent utilisation of information relating to social care recipients.

2. Action planning – considering alternative courses of action for solving the problem that has been diagnosed

It was decided to explore the feasibility and desirability of utilising group interactive training methods, using the Teamworker GSS, in a pilot study.

3. Action taking – selecting and implementing a particular course of action to solve the problem

This course of action was piloted with four training groups, involving professionals from various areas of social care. Standard cases were selected which, it was believed, were known to all members of a particular training group. Two different social process protocols were tested:

- a. Summary feedback of histograms after all responses had been obtained for all 17 variables
- b. Summary feedback of histograms on a variable by variable basis

4. Evaluating – studying the consequences of the course of action selected

The application of the Teamworker GSS was investigated by analysing the degree of individual learning that had been achieved in respect of understanding of the 17 Gerix variables.

The value of the technology was also assessed through collecting feedback from the individual participants in each training group.

5. Specifying Learning – identifying general findings on the basis of the evaluation

The pilot study was deemed successful, in terms of the achievement of individual learning, by TeamStandards. The Teamworker GSS was therefore adopted as a standard training system for use in training professional care workers in the interpretation of the Gerix model, and has been used by TeamStandards (without any additional support) to support the training of a number of professional groups. I have been supplied with Teamworker data from these additional training sessions that has enabled additional analyses to measure the degree of individual learning achieved. On the basis of the results obtained from using Teamworker GSS to support professional group training in the Gerix framework, the Teamworker system has now been utilised in a similar application with Danish social services.

This project is again reported using a case study methodology, so again data has been obtained and used from a number of sources, including personal reflections, conversations and interviews with the TeamStandards personnel and group members, journal articles, and the data collected through using the Teamworker GSS.

3.7 Providing the Overview

The three projects discuss different aspects of a particular Group Support System known as Teamworker. Project One considers the development of a novel GSS, and applications of this GSS. The academic literature and my own personal reflections have been used to guide the development and applications, and these have in turn spawned

further academic literature which has helped in our understanding of the usefulness of group support systems. Projects Two and Three both evaluate the Teamworker GSS in specific ‘real world’ contexts, rather than laboratory situations. Because the contexts are very different, the evaluation is also necessarily very different in each case.

4 Review of Project One - Development and Applications of a Group Support System (GSS)

4.1 Objectives of Project One

Project One (Development and Applications of a Group Support System) considers the development of a new and novel type of GSS. The objectives of this project are:

1. Using an Action Research approach, discuss the development and implementation of the Teamworker GSS over a 15-year period, including the hardware and software developed over this period. As part of this project, the Teamworker GSS (hardware and software) is also presented as a completed artefact, and is available for review and experimentation.
2. Review nine Teamworker applications that have been reported in the academic literature, business journals and newspapers, using a series of case study 'vignettes'.
3. On the basis of the development and applications of the GSS, develop a GSS Design Framework and GSS Design Guidelines that can aid the development and implementation of Teamworker applications.
4. Discuss the perceived value of the GSS through the applications reported in this project, and how these applications relate to the GSS academic literature.

4.2 Development and Applications of the Teamworker GSS

The development of the Teamworker Group Support System stems from two separate experiences. The first of these was organising and feeding back the results of Military Judgement Panels (MJPs). It was felt that if MJP members could respond to questions anonymously and obtain summarised feedback of the individual opinions in real time, this would encourage focussed discussion on the important issues leading to greater insight, and would reduce domination by higher status members of the group. This point of view is also supported by the academic literature into Group Support Systems, where it is argued that an additional (anonymous) channel of communication should

reduce group process losses, such as the effects of domination by individual members of the group, and improve group process gains, such as improvement in the understanding of issues (for example Huber, 1982; DeSanctis and Gallupe, 1987; Nunamaker *et al*, 1991). The second experience was a first development of a hard-wired system of handsets to enable a decision-making group to review feedback of its feelings in relation to progress on the task (Gear *et al*, 1985).

Most Group Support System developments have involved networked personal computer approaches (known as w-GSS by Watson *et al*, 1994), such as GroupSystems and SAMM, and the majority of academic research into GSS is concerned with these types of systems (e.g. Pervan, 1998:155). Such systems require a large investment in equipment, and also require the use of a dedicated ‘decision room’ that contains the system. The Teamworker GSS was designed to be a more portable system that could be used in any meeting room, and easily taken from room to room, using only a single personal computer (or laptop computer), a large screen (using an overhead projector) and a number of portable handsets that could send messages to the computer using radio telemetry (this type of system is known as a k-GSS by Watson *et al*, 1994). This is ‘low-impact’ technology, as the technology supports the meeting environment but does not dominate it. The system is highly portable, and can be set up and be operational within 10 minutes. The configuration of the completed Teamworker GSS is shown in Figure 5.

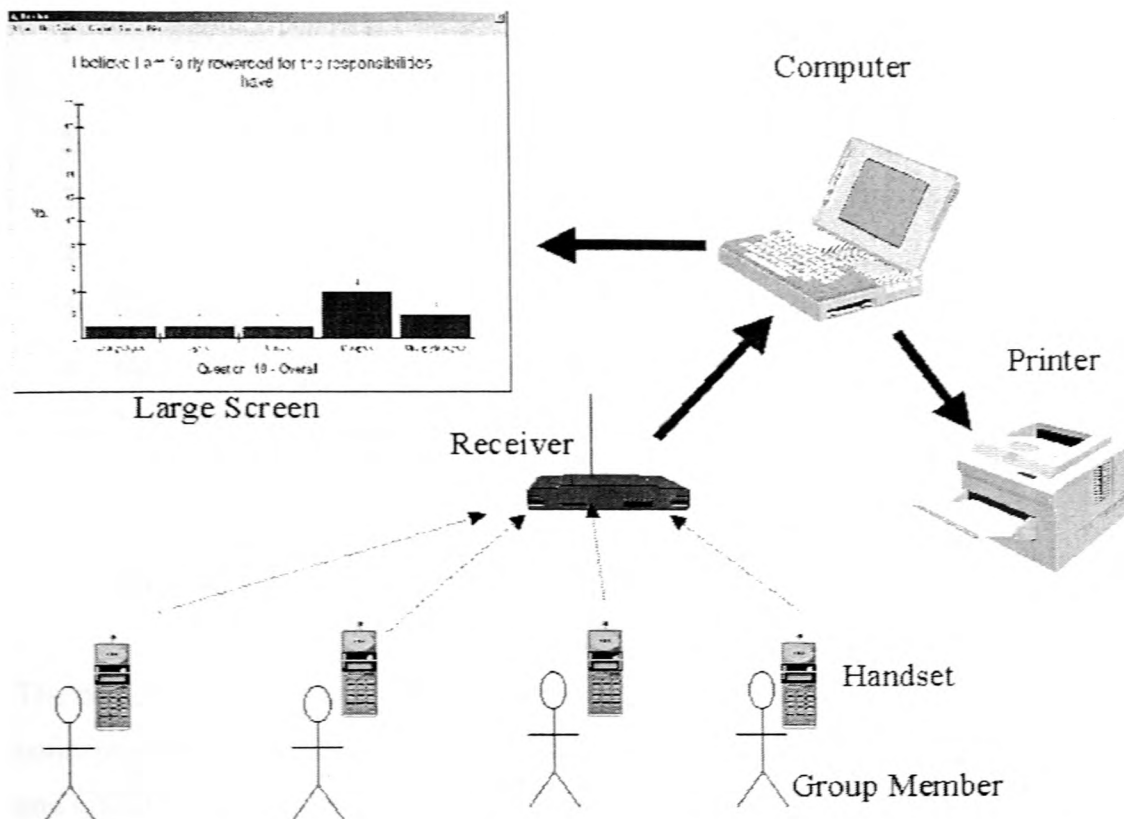


Figure 5: The Teamworker Group Support System

An early type of hard-wired k-GSS is described in Gear *et al* (1985). Other k-GSS have been independently developed around the same time as Teamworker, the most well-known and used of these being OptionFinder, developed in Utah, USA (e.g. Flexner, 1995). This system was originally developed using hard-wired technology, a technology that I believe was intrusive for managerial groups (OptionFinder has since implemented radio telemetry handsets, using advice provided on the basis of experiences with Teamworker). A further difference is that OptionFinder typically relies on standard feedback screens (for example X-Y grids) whereas Teamworker applications have often required unique and purpose developed feedback screens (Appendix F identifies some of the group feedback screens developed for different Teamworker applications). This degree of willingness to customise is a natural consequence of the action research methodology that has been adopted.

The field applications considered by this project are:

1. SmithKline Beecham Pharmaceuticals – Portfolio Selection in Commercial Research and Development
2. UK Ministry of Defence – Option Selection in Defence Systems
3. US based multinational oil corporation – Long Range Strategic Planning
4. Pharmaceutical University-Based Professional Education
5. Carlsberg-Tetley – Panel Testing and Tasting
6. Bayer plc – Developing Action Plans
7. Northamptonshire County Council – Validation of a Client Assessment Model
8. Engineering and Physical Sciences Research Council (EPSRC) – Funding of Technology Research Areas
9. Bass Brewers – Organisational Learning

The development of Teamworker and the associated field applications have led to the conceptual developments of a Group Feedback Framework, a GSS Design Framework and GSS Design Guidelines that help in our understanding of how a GSS such as Teamworker can be designed and used with a group.

4.3 Group Feedback Framework

A Group Feedback Framework that defines how inputs are obtained from individual group members, processed and summarised in some way using a personal computer and then fed back to the group using a large screen in ‘real time’ is shown in Figure 6.

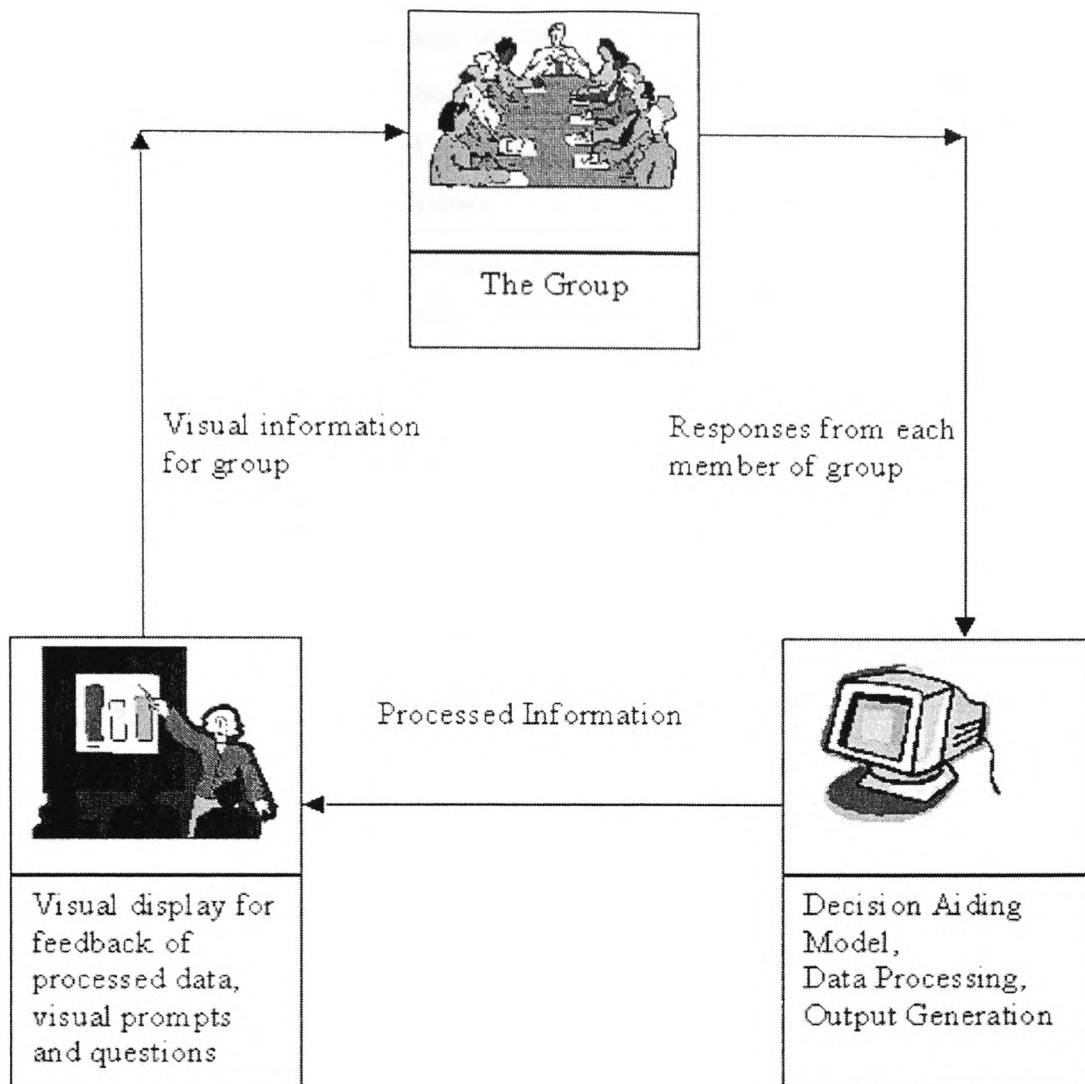


Figure 6: The Teamworker Group Feedback Framework

The contention is that:

1. This feedback will enable differences to be understood in a non-threatening manner
2. This will encourage discussion and dialogue within the group as group members attempt to understand each other's points of view.
3. This will lead to group 'process gains' and reduce group 'process losses', thus producing a more effective group process.

A number of judgemental processes can be built into the framework, including:

- Voting/Polling. E.g. selecting an item or option from a set; multiple choice answers
- Scoring options. E.g. evaluating each of a set of items or options on a pre-defined scale; scoring as a means of producing lists in rank order; scoring as a means of filtering long lists into short-lists.
- Comparing options. E.g. weighting the relative importance of a set of criteria by means of pairwise comparisons; evaluating subjective factors and parameters; assessing subjective probabilities and probability distributions; assessing attitudes to risk.
- Direct assessment. E.g. the estimation of parameters, probabilities and other factors by direct and subjectively based inputs

These judgemental processes can also be included in a decision analytic model (e.g. a multi criteria decision making framework). However, users will need to think carefully about the selection of a suitable decision analytic model to use, especially as many such models have been originally designed for individual and not group use.

4.4 Group Support System Design Framework

The applications of the Teamworker GSS have enabled a Group Support System Design Framework to be developed. This is shown in Figure 7, and depicts a series of interlinking factors, demonstrating that there are dependencies between many of the different factors that must be considered when designing a GSS application. The major factors identified in this framework are:

- *Context, Group and Task Characteristics*: before a GSS can be designed, the context and group task needs to be understood as thoroughly as possible.
- *Decision-Aiding Framework*: a number of decision-aiding frameworks may be considered, but whichever is adopted must fit with the context, group and task characteristics, as well as with issues of task de-composition.
- *Social Process Framework*: issues such as anonymity, role of the group leader, use of Group Delphi and other group techniques, as well as the ordering of the meeting, will need to be compatible with the decision aiding framework and the nature of the task and context.

- *Protocol of Social Process involving the GSS*: how the GSS is going to be used with the group needs to be carefully designed and agreed with the group.
- *Appropriate Hardware and Software Design*: having gained some understanding of each of the elements above, then appropriate hardware and software can be designed and developed.

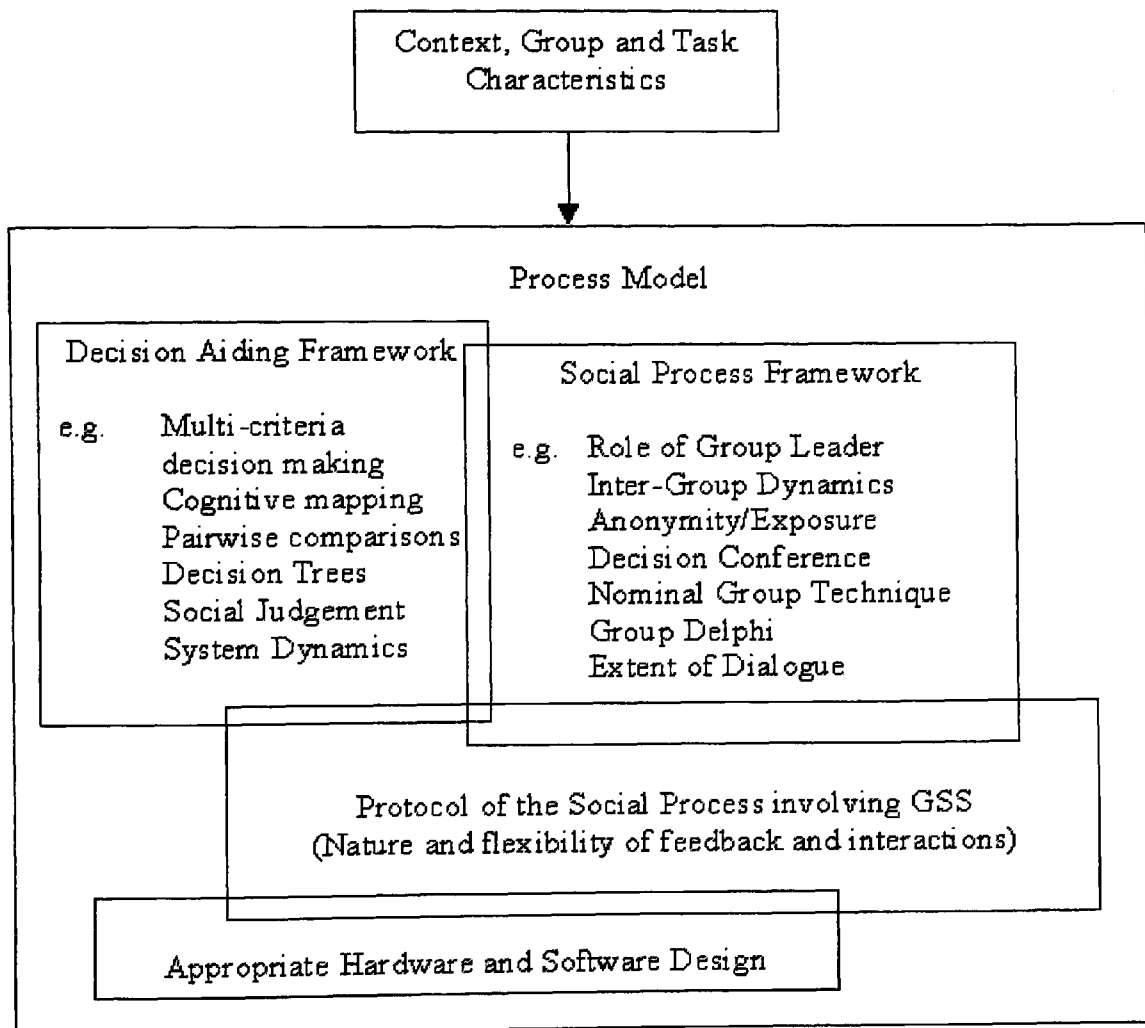


Figure 7: Group Support System Design Framework

The GSS Design Framework suggests that when designing a new GSS application, the problem becomes one of appropriate selection of a decision aiding framework, to operate in conjunction with a selected process framework, in order to implement a suitable protocol for the social process involving the GSS, for a given context and task.

Gallupe and McKeen (1990: 11) have suggested that “...*the use of GSS technology should be fine-tuned to the task and setting for which it will be used.*” Dennis *et al* (1989: 301) further argue that GSS researchers need to make explicit design decisions for aspects such as organisational context, group characteristics, tasks and GSS environments.

I believe that the technology of group support should seek to aid and enhance group processes and not inhibit or dominate them, and this will require careful attention to design aspects concerned with the process model. This might require more than selecting from a pre-defined list of menu options that might be available with typical Group Support Systems, or accepting a particular decision analytic framework, as might be the case with particular type of facilitator led single personal computer GSS. Rather, the GSS will need to be carefully designed, in collaboration with the group who are to use the system, to meet the task and process needs of the group.

4.5 Group Support System Design Guidelines

The GSS applications reported in this project have enabled the identification of a number of design guidelines that can help focus the design of the Teamworker GSS in varied settings. These are:

1. Each participant should be fully involved in those stages of the process that are not pre-ordained by the context. In particular, setting objectives, generating alternatives, establishing and defining criteria with which to judge alternatives. These should be openly discussed, changed and filtered as the meeting progresses in a dynamic way.
2. As a means of identifying useful points of debate, and aiding meaningful discussions, all participants should have opportunities to input their judgements in terms of evaluations of the alternatives against each of the criteria, one with another, at a series of defined stages. At each stage, the complete set of inputs should be received prior to display to minimise social biasing effects.

3. Feedback of evaluations at each stage should be simple and graphic, displaying the set of values received from the group in a transparent way, with as little processing as possible, enabling a discussion of points of agreement and of disagreement (especially of polarised views).
4. At any stage, a display of differences of opinion followed by dialogue may indicate the need to revisit that stage or any earlier stage of the process, and this should be taken when necessary.
5. At some stages, it may be useful to aggregate results from each of the participants in some mathematical process of, for example, adding or averaging. On each occasion, this process should be made very clear to the group as well as any inherent shortcomings it may contain.
6. As a result of the inputs, feedbacks, discussions and analyses, the group should reach a collective choice, which is an agreed and preferred result, achieved by means of dialogue.
7. The technology of decision support should seek to aid and enhance group processes and not inhibit or dominate them, which requires careful attention to design aspects concerned with both hardware and software. This may require especially developed feedback screens.
8. Procedures and evaluation methods should be constructed to build on from cultural settings and prior experience of the group as part of a joint learning and development experience. These aspects may need attention in advance.
9. Questions requiring input of judgement from participants should normally be formulated in clear and unambiguous terms.

4.6 Discussion of Project One

There has been limited academic research published concerned with handset based group support systems – the Literature Review identifies some of the published research articles on these types of system. It is interesting that Watson *et al* (1994: 123) describe k-GSS as ‘less glamorous’ than w-GSS, and this may be a reason for the substantially less research available on this type of system. This portfolio of work is a unique contribution to the knowledge base on this type of system, albeit specifically concerned with the Teamworker system. The applications described in this project also support other published work that is available for group support system applications in the field.

For example, field studies have consistently shown high satisfaction ratings with groups that use a group support system (e.g. Nunamaker *et al*, 1993; Chun and Park, 1998). The comments received from participants using Teamworker in the applications reported in this project are also consistently positive. Participant evaluations are also positive, for example the Northampton County Council and Bass Brewers applications. Many informal communications between myself and meeting participants confirm this view – the vast majority of informal comments on the use of the system have been positive from a user satisfaction point of view. As Eden (1995: 308) argues, unsolicited comment may be a more reliable method of obtaining evaluation information from management groups making use of a GSS than more formal approaches, such as a questionnaire approach. However, it should also be noted that users can be happy with a methodology that may be flawed (e.g. Belton and Gear, 1982).

Research on group support systems suggest that a GSS can support a less confrontational and threatening environment, often because of the ability of participants to give their opinions anonymously and without undue influence from other members of the group (e.g. Nunamaker *et al*, 1993; Watson *et al*, 1994). This is also supported by the comments of participants in the applications reported in this project, e.g. SmithKline Beecham, Ministry of Defence, Bass Brewers and Pharmaceutical Education.

GSS research suggests that process structuring helps to keep the participants focused on making the decision, reducing tendencies toward digression and unproductive behaviour

(e.g. Nunamaker, 1993 *et al*; Watson *et al*, 1994). Support for these observations can be found in the comments of participants from the SmithKline Beecham, Ministry of Defence and Carlsberg-Tetley applications reported in this project.

Nunamaker *et al* (1997) and Watson *et al* (1994) have identified a number of other issues, specifically concerning handset based group support systems (and reported in the Literature Review) that find support in the applications reported in this project:

1. GSS polling can be used to clarify communication, focus discussion, reveal patterns of consensus or stimulate thinking (e.g. SmithKline Beecham, Ministry of Defence, Carlsberg-Tetley).
2. GSS polling can demonstrate areas of agreement, allowing groups to close off discussion in those areas and focus only on areas of disagreement (e.g. SmithKline Beecham).
3. GSS polling can fuse the aggregate judgement or opinions of all group members into a true group position. (e.g. Oil corporation, EPSRC, Bayer plc).
4. Meetings can have more participants without loss of effectiveness (e.g. Oil corporation).
5. GSS polling can be used to formally register dissenting opinions (e.g. SmithKline Beecham).
6. GSS polling can shorten the meeting time (e.g. SmithKline Beecham).
7. Polling methods in decision groups need not be democratic (e.g. SmithKline Beecham).

Much of the feedback and many of the comments received from participants in the applications and sponsors of the applications reported in this project have been very positive. However, many of the organisations discussed in the case studies have also discontinued use of the system. A number of reasons for this may be identified:

1. Requirement for an internal ‘Champion’ to illustrate how the organisation can benefit from the use of a Group Support System.
2. Organisational changes that make the use of the system obsolete.

3. Lack of Top Management Support. The use of a GSS can affect the power structures within groups, which may be to the detriment of certain powerful individuals.
4. Technological Issues. The GSS must operate perfectly to be accepted by the group. If the GSS is not totally reliable in a particular situation, or the environment is not conducive to its use, then its use is likely to be discontinued.
5. Despite positive feedback, users may feel that any benefits of using a GSS do not outweigh the costs.

From the field applications discussed in this project, the Teamworker GSS does appear to have value in certain situations, particularly where individual learning and the encouragement of dialogue and discussion is important within a particular context. In decision making situations involving senior managers, where the context will necessarily be different from application to application, and where individual power may be an important concern, the value of the system is often difficult to ascertain.

Evaluation of a GSS is a complex task, and can involve a variety of approaches, as identified in the Research Framework for GSS Evaluation. Projects Two and Three of this portfolio enable a more in-depth evaluation to be undertaken, as these projects involved a number of different groups meeting over a number of years.

5 Review of Project Two - Use of a Group Support System in Research Committees

5.1 Objectives of Project Two

This project is concerned with the development and implementation of the Teamworker GSS with a public-sector Research Award Body, and the continued use of the system by the Award Body over a 5-year period to support Research Committees ranking research proposals. The objectives of this project are as:

1. Using an Action Research approach, discuss the development and implementation of the Teamworker GSS with the Award Body.
2. Evaluate the satisfaction of the Award Body officers on the usefulness of the system (people centred evaluation approach).
3. Evaluate the process used to produce research proposal rankings through using the Teamworker GSS, in terms of the robustness of the funding decisions made (process centred evaluation approach).
4. Discuss the significance of this evaluation in terms of GSS design effectiveness.

5.2 Discussion of Project Two

The design objectives of the Teamworker GSS in this application was to support the Research Committees to enable funding advice to be given to the Award Body Central Office in a relatively short period of time, and to reduce domination by a few committee members.

It would appear that Award Body Officers were extremely satisfied with the Teamworker GSS. The system was utilised continuously over a five-year period to support ranking of research proposals by each of the Research Committees. Award Body Officers found that the system was useful as it:

- Made their life easier, in that all scoring inputs were automatically captured.

- Helped committee members become more consistent in their scoring.
- Reduced domination by a few committee members. In discussions with Award Body Officers, this had been noted as a problem in previous research proposal ranking exercises.
- Enabled the agenda to be completed. For some Research Committees the agenda was extremely large, with over 200 proposals to be considered (including projects that were rejected following discussion and therefore not scored). The Award Body Officers felt that the introduction of the GSS had enabled the research proposal ranking exercise to be better structured, and that the use of the handsets enabled the chairperson and Award Body Secretary to contain and curtail discussion when necessary.

Although the reactions of the members of the Research Committees were more varied, the members of the Research Committees did accept the system, and it was used continuously by the different Research Committees over a five-year period, and until the functions of Award Body were taken over by another institution following a reorganisation. Therefore, in terms of a people centred evaluation approach, the GSS would appear to be successful.

However, the evaluation of the process does give cause for concern. The data relating to 28 separate committees meeting over a number of years have been analysed to determine the sensitivity of the rankings produced on a number of different factors. The committees ranged in size from 7 to 19 members and the number of proposals ranked by each committee was in the range 4 to 105.

Data from the individual member scores has been used to assess the impact of 'Position in Agenda' and the 'Financial Value of the Proposal' of each proposal in the meetings analysed. The conclusion in connection with the first of these issues (Position in Agenda) is that rank orders are unlikely to be significantly affected. For the second of these issues (Financial Value of the Proposal) the rank order does appear to be correlated for a small number of the committees but there does not appear to be any overall pattern or systematic effect.

Of more significance, however, data from the individual member scores has also been used to assess the significance of the “Scoring System Used” in terms of coarsening the 5 point scale to 3 points and of the use of the median rather than the mean as the ranking method. In both these cases, a statistical analysis using rank correlation showed very high rank correlations between the original and the modified rankings of proposals.

A closer investigation of the data, concentrating attention on the changes in ranked positions of individual proposals, is more interesting. Using committee data, it can be shown that major changes in the rank positions can result from changing the scoring scale used, and from using the median rather than the mean, as the method of producing an aggregate score for a proposal. The effects of the rank order changes that are demonstrated are important to the quality of the decisions reached by the committees, despite the rank correlation coefficients being impressively high. Either of these changes to the design of the scoring process may result in changes to the sets of proposals selected for funding.

Additionally, the effect of disregarding one member’s scores has been analysed. Examination of these results suggests that disregarding a member’s score, and not necessarily a member perceived to be an ‘outlier’, can result in significant rank switches. This effect varies depending upon whether the mean or the median is used as an aggregation method to derive the ranked list of proposals. The effects are such that changes in the set of proposals selected for funding could result.

The people centred evaluation of this application suggests that the design objectives were successfully met. However, despite the apparent usefulness of the Teamworker system from the viewpoint of the Award Body Officers, the process used to make funding decisions does not appear to be very robust, as different funding decisions may have been made if different scoring scales or aggregation methods had been used, or if an individual committee member’s scores for a proposal was disregarded.

6 Review of Project Three - Using a Group Support System to Aid Development of Professional Judgement

6.1 Objectives of Project Three

This project is concerned with initial trials of the Teamworker GSS with groups being trained to apply the Gerix multi-criteria framework used for the evaluation of clients requiring social care, and the subsequent adoption to support all training groups for professional judgement training in the application of the Gerix method for client evaluation, with the support of the Norwegian Government. Additionally, the use of the system in a similar context has now been extended to Denmark, where a client assessment framework (known as ‘Common Language’) for elderly care similar to the Gerix framework has been developed. The objectives of this project are as follows:

1. Using an Action Research approach, discuss the development and implementation of the Teamworker GSS for use with groups training to use the Gerix framework.
2. Evaluate the group process in terms of the range of assessments produced and the effect of the initial group majority (process centred evaluation approach).
3. Evaluate the type of learning achieved through use of the GSS and associated group process during the initial trials (output evaluation approach).
4. Evaluate the degree to which individual participants move closer to the known ‘correct’ scores (output evaluation approach).
5. Evaluate the value of the technology using feedback of participating group members and the Project Manager charged with organising the training in the use of Gerix (people centred evaluation approach).
6. Discuss the significance of this evaluation in terms of GSS design effectiveness.

6.2 Discussion of Project Three

The design objectives of the Teamworker GSS in this application were to use the GSS to encourage participants in a training session to share their judgements with others in an environment with reduced domination effects from higher status members, to

provide opportunities to discuss these judgements, and through this process provide a learning experience in the Gerix framework to improve professional judgement.

The process model adopted in the initial trials was found to encourage a discussion of differences of opinion, by displaying the initial assessments as a bar chart. This process model is shown in Figure 8.

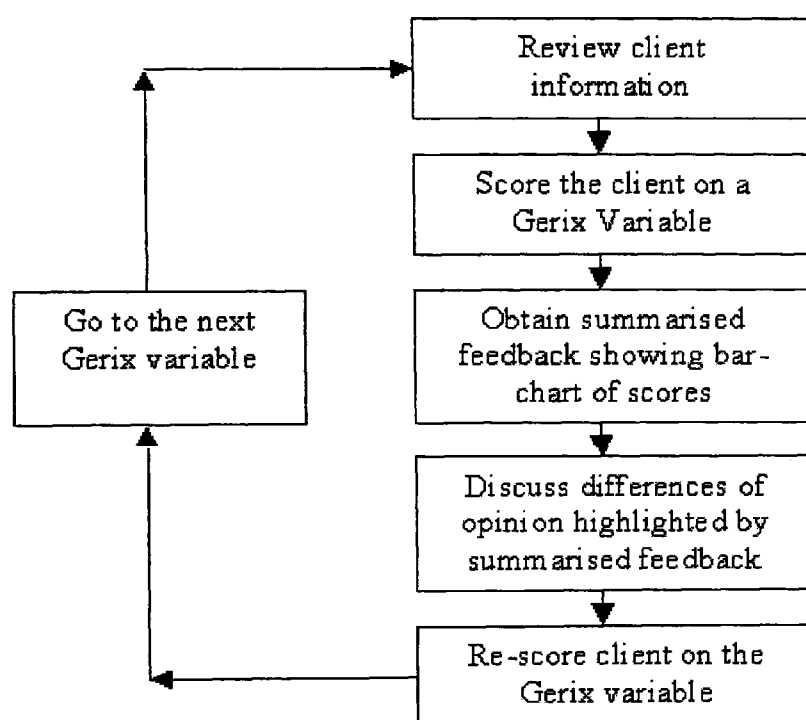


Figure 8: Process Model used for Project Three

The proposition was that, after discussion, participants would sometimes change their ratings of a variable as a result of learning more about the client, or about the appropriate use of the Gerix model of assessment from each other, and would improve their consistency of judgement.

The data collected has been explored in a variety of ways in order to evaluate the use of the Teamworker GSS from a number of perspectives. The results of the analyses undertaken leads to the following conclusions:

1. Changes of opinion frequently occur following the feedback of initial assessments coupled with discussion.

2. The dominant initial opinion (as identified by the initial modal value) has limited effect on these changes.
3. There is a greater degree of agreement among the participants (as measured by the range of assessment) following the feedback of the initial assessments and the ensuing discussion.
4. There appears to be rapid learning of the Gerix variables, in terms of how to place clients on the 1 to 4 scale in a consistent manner.
5. The participants in the initial trials appear to be very positive about the use of Teamworker as a support tool for professional judgement training in this context.
6. The Gerix Training Project Manager believed that the initial trials had been extremely successful, and demonstrated the benefit of using such a system in this particular training context.
7. Because of the perceived success of the trials, the Teamworker GSS has been adopted as a training support tool for generalised Gerix training, and has been used in this role for over five years (and up to the time of writing). Additionally, the Teamworker GSS has now also been adopted as a training support tool for group training in a similar framework in Denmark.
8. An analysis of seven training groups undergoing generalised Gerix training has shown that three Gerix variables require redefining to be less ambiguous, and that participants, if initially selecting an incorrect value for a Gerix variable, are likely to go towards the correct value following the feedback and discussion of the group scores.
9. Participants in these training groups appear to be very positive that the objectives of the training sessions have been achieved. Additionally, the participants in the 'Common Language' (a similar framework to Gerix used in Denmark) training sessions appear to be very positive about the use of the Teamworker GSS to support professional judgement development.

I am not aware of any other application where a handset based GSS is used in this way to support professional judgement development in the use of a standardised framework (such as 'Gerix' or 'Common Language'). Other research does, however, support the use of a GSS in a learning environment (e.g. Walsh *et al*, 1996; Irving and Hunt, 1994;

Alavi, 1994; Khalifa and Kwok, 1999; Leidner and Fuller, 1997; Jones *et al*; 2001; Gear *et al*, 2003).

These results support the proposition that group members are revising their assessments as a result of the dialogue that occurs when the feedback bar chart is shown to the group after initial scoring. The analyses in this project support the argument that that these revisions are based on clarification of the Gerix framework, rather than simply conforming to the dominant group position, and this proposition is supported by the comments made about the process by the Gerix project manager and Gerix training programme manager. Also, feedback from participants in terms of the effectiveness of the approach is encouraging, and the project managers charged with providing the training programme in both ‘Gerix’ and ‘Common Language’ are very positive of the benefits of using the Teamworker GSS in this context.

7 Discussion of the Portfolio

The Teamworker GSS has been developed over a number of years, and has been applied in a number of different organisational contexts. This Overview has identified that there appears to be limited written evidence of the efficacy of systems such as Teamworker in the academic community, therefore this portfolio of work is a unique contribution to the knowledge base on this type of system, albeit specifically concerned with the Teamworker system. Additionally, much of the GSS research that has been undertaken has involved relatively small groups – for example in the review of empirical studies by Fjermestad and Hiltz (1999), 72% of the 200 studies involved groups of 5 members or less. The research reported in this portfolio concerns group sizes of between 5 and 43 members.

Project One discusses the development of Teamworker and a number of the Teamworker applications. The feedback from participants' in these applications appears to be very positive in terms of the satisfaction of the participants with the system, and this supports other GSS field-based literature. Other positive findings include a reduction in domination effects and a less threatening environment, again supportive of previous GSS literature. However, in a number of cases the use of Teamworker has been discontinued for a variety of reasons including the loss of an internal 'champion' and organisational changes.

Evaluation of a GSS is a complex issue, and can be considered from a number of perspectives and approaches. Three approaches have been identified in the Research Framework for GSS Evaluation – People Centred evaluation, Process Centred evaluation and Output evaluation. These approaches have been applied through two in-depth case study evaluations (Projects Two and Three). These two case studies were chosen as the GSS applications had been in use over a number of years in many meetings in each case.

From a people centred evaluation, the Award Body application appears to have been a great success. The Award Body Officers found the system beneficial, and it was used by Research Committees over a five-year period. However, a process centred

evaluation identifies major concerns over the process used to make funding decisions, as different funding decisions may have been made if different scoring scales or aggregation methods had been used, or if an individual committee members' scores are disregarded.

From a personal perspective, I believe that a problem with the process was the limited amount of time given to discussion of the inputs at each stage of the process. One of the reasons for using a GSS is to encourage differences of opinion to be identified and discussed. However, the members of the Research Committees had little time to discuss a proposal following feedback of the scoring of a particular proposal – even when there appeared to be disagreement within the committee. A reason that so little time was allowed for discussion was the large number of proposals that each committee had to consider at each meeting.

The effect of this limited discussion time is decreased robustness of the funding decisions made through the process, although it is accepted that there was limited time available for additional discussions. The discussion of the scores following feedback on a large screen may lead to a reduction in the variability of individual scores for each proposal (see, for example, Read *et al*, 2003, and Project Three of this portfolio). Any reduction in variability is likely to improve the robustness of the process, in terms of scoring scales used, methods of aggregation and membership of the committee.

The GSS Design Guidelines identified in Project One state that

As a result of the inputs, feedbacks, discussions and analyses, the group should reach a collective choice, which is an agreed and preferred result, achieved by means of dialogue

(Section 4.5).

It is contended that insufficient process time was allowed for dialogue, and that this resulted in some of the problems identified in the analyses conducted in Project Two. It is recognised that, in this particular context, there wasn't sufficient time for adequate discussion to take place due to the number of research proposals that had to be considered at each meeting. Nevertheless, this is a considerable criticism of the process model that

was used at the Award Body Committee Meetings, despite the fact that the use of the Teamworker GSS would be judged a success from the point of view of the Award Body officers. All participants, and any others who use similar methods for ranking items, should appreciate this lack of robustness of the ranking method – indeed a further GSS Design Guideline states:

At some stages, it may be useful to aggregate results from each of the participants in some mathematical process of, for example, adding or averaging. On each occasion, this process should be made very clear to the group as well as any inherent shortcomings it may contain

(Section 4.5).

There is an outstanding need for further research to address the issues of developing scales of appropriate fineness in terms of scale points, and of selecting an appropriate method of aggregating individual member scores for committees engaged on this type of task.

In contrast, Project Three evaluates an application of the Teamworker GSS where the process model adopted does allow and encourage dialogue between the group members whenever required. The process model adopted was found to encourage a discussion of differences of opinion, by displaying the initial assessments as a bar chart. The proposition was that, after discussion, participants would sometimes change their ratings of a variable as a result of learning more about the client, or about the appropriate use of the Gerix model of assessment from each other, would improve their professional judgement in the application of the Gerix framework. In analysing the data produced at the Gerix group sessions, this was found to occur.

It is very difficult to directly compare or generalise the evaluation of a GSS between different applications, as the context of each application is different. However, the application discussed in Project Three, where the process model adopted encouraged dialogue, appears to be successful in achieving the design aims, which are to encourage individual learning of the Gerix framework within a group setting. The process model used in the application discussed in Project Two, where the opportunities for dialogue were far more limited, does have shortcomings.

Additionally, the application in Project Three provides further evidence for the argument, presented in Project One, that the Teamworker GSS appears to have particular value in those situations where individual and/or collective learning, and the encouragement of dialogue and discussion is important. However in strategic decision-making situations the value of the technology is far harder to determine, as the context is likely to vary greatly between applications, the power relationships between group members and the nature of the members themselves are likely to be important factors, and an improvement in effective dialogue may not be an important objective for some group members.

The cases in the portfolio demonstrate that if an application is concerned with improving dialogue between members of a group, meeting for some task, then the GSS can be a positive aid to the group process. Whether such generalisations can be extended to other types of GSS, including other k-GSS, has not been answered in the research discussed in this portfolio. The type of application that is concerned with individual learning and the generation of dialogue is less complex, in terms of supporting decision-analytic techniques, than applications requiring decision support for strategic decision making, and therefore it is likely that other k-GSS would be equally effective at supporting this type of application. However, there will always be issues concerned with GSS design and the skill with which the GSS is used, as is the case with other types of specialised technology. Only a continuing and reported use of both this and other GSS by other users in the future will enable further insights to be gained in order to respond more fully to Finlay's (1998:200) central question, that is that GSS research should attempt to *"articulate understanding to answer the question: What is the appropriate support for a group in the context it finds itself?"*

8 Conclusions and Future Research – Nature of the Contribution to Knowledge

This portfolio of work has considered three separate projects concerned with the development, application and evaluation of a Group Support System. Together with this overview they comprise a substantial contribution to knowledge relating to handset based group support systems, as follows:

8.1 *Group Support System Design Framework*

The different field applications using Teamworker discussed in this project have involved a variety of task types, contextual situations and process models. The process model used to support a group task will involve a number of different elements including a social process framework, a decision aiding framework and a protocol of social process involving the GSS. This process model will inevitably vary to reflect the task type and contextual situation. Finally, software and possibly hardware may need to be developed to reflect these variables.

Given that task type and the contextual situation can be understood (which requires a great deal of discussion with the groups who may wish to use a Group Support System) there are still a large number of possible operational system designs of a GSS that may be able to support the group complete the group task. A GSS Design Framework that identifies the complexity of the design issues and which has emerged from the applications of the GSS. This Group Support System Design Framework, an output from Project One, is displayed in Figure 7, and shows a series of interlinking factors, demonstrating that there are dependencies between many of the different factors that must be considered when designing a GSS application for a specific task and context. The GSS Design Framework discussed in more detail in Section 13 (Project One).

8.2 *Group Support System Design Guidelines*

The GSS applications reported in this project have enabled the identification of a number of design guidelines that can help focus the design of the Teamworker GSS in

varied settings. These are briefly identified below, and are discussed in more detail in Section 14:

1. Each participant should be fully involved in those stages of the process that are not pre-ordained by the context.
2. As a means of identifying useful points for discussion, all participants should have opportunities to input their judgements at a series of defined stages. At each stage, the complete set of inputs should be received prior to display to minimise social biasing effects.
3. Feedback of evaluations at each stage should be simple and graphic, displaying the set of values received from the group in a transparent way.
4. At any stage, a display of differences of opinion followed by dialogue may indicate the need to revisit that stage or any earlier stage of the process.
5. At some stages, it may be useful to aggregate results from each of the participants in some mathematical process of, for example, adding or averaging.
6. The group should reach a collective choice, which is an agreed and preferred result, achieved by means of dialogue.
7. Careful attention to design aspects concerned with both hardware and software to ensure that the GSS enhances the group process.
8. Procedures and evaluation methods should be constructed to build on from cultural settings and prior experience of the group.
9. Questions requiring input of judgement from participants should normally be formulated in clear and unambiguous terms.

8.3 A Research Framework for GSS Evaluation

A Research Framework for GSS Evaluation has been developed for this research, and this is shown in Figure 4. The framework shows an Input-Process-Outcome model, but with a concentration on:

- The identification of the context, group and task characteristics.
- The identification of the important GSS design elements.

- The group process variables that can be measured in the case studies analysed in Projects Two and Three.
- The outcome variables that can be measured in the case studies analysed in Projects Two and Three.
- The three evaluation approaches (people, process and output evaluation approaches) considered important in this research.

This evaluation framework has enabled a degree of objectivity and focus to system evaluation in the field, and this framework has been applied to enable the evaluation of the GSS applications discussed in Projects Two and Three. This Research Framework for GSS Evaluation is discussed in more detail in Section 3.5.

The application of this Research Framework for GSS Evaluation with Project Two has identified that contradictory evaluation results can be obtained. A process model involving the use of a GSS can give high satisfaction to some important stakeholders but may involve decision quality issues that have not been properly considered and understood (see Section 7). This emphasises the need to consider evaluation of a GSS from each of the three perspectives identified in the Research Framework for GSS Evaluation where possible.

8.4 Issues with a Group Ranking Model

The evaluation of the application for Project two has identified serious concerns with the application of a commonly used group-ranking model involving scoring, averaging and ranking of a set of options (see Section 5.2). Using actual committee data, it can be shown that major changes in ranked order can result from different methods of aggregating individual inputs to produce group rankings. In particular, major changes in the rank positions can result from changing the scoring scale used and from using the median rather than the mean as the method of producing an aggregate score for a proposal. The effects of the rank order changes that are demonstrated are important to the quality of the decisions reached by the committees, although the rank correlation coefficients are impressively high. Either of these changes to the design of the scoring process may result in changes to the sets of proposals selected for funding.

Additionally, the effect of disregarding one member's scores has been analysed. Examination of these results suggests that disregarding a member's score, and not necessarily a member perceived to be an outlier, can result in large rank switches. This effect will differ depending upon whether the mean or the median is used as an aggregation method to derive the ranked list of proposals, however the effects are such that changes in the set of proposals selected for funding could result.

8.5 *Enhancement of Social Learning*

The evaluation of the application for Project Three has identified the efficacy of this form of low impact GSS technology to enhance social learning by means of dialogue that focuses on differences of opinion in order to promote improvement in professional judgement (Section 6.2). In particular, the evaluation of this project has demonstrated that members of a group do not simply follow the majority viewpoint when discussing differences of opinion, and that group members improve their professional judgement and understanding of the Gerix framework through the dialogue that is encouraged in the social process adopted by the training groups involving the use of the GSS.

8.6 *Future Research*

There are a number of avenues available for future research that can build on the work reviewed in this portfolio:

1. Project Two has identified concerns about a well-used model for ranking options in a group situation (i.e. using a scoring scale and using the mean responses as the basis for producing a ranked list). Different ranks can result on the basis of the scoring scale used and the method of aggregation used. Further research should address the issues of developing scales of appropriate fineness in terms of scale points, and of developing and testing the methods of aggregating member scores for groups engaged on this type of scoring and ranking task.
2. Project Three has argued that the use of the GSS to encourage participants in a learning situation to share their judgements with others has been successful in

developing professional judgement. The use of the GSS in other learning situations (e.g. Pharmacy Education, described in Project One) also supports this view. Further research should be aimed at identifying how such a GSS can affect the learning environment in other contexts, and in what way learning outcomes can be improved through using a GSS.

3. A number of applications have been discussed in Project One, and two specific applications have been the subject of in-depth evaluations in Projects Two and Three. Further applications in a variety of contexts should be evaluated subject to the Research Framework for GSS Evaluation identified in the Methodology chapter to establish the variables that can be evaluated and the methods that can be used for the evaluation.
4. The outputs from Project Three support the view that encouraging dialogue in a non-threatening environment can create the basis for learning and change. It has also been argued that the limited time available for dialogue in Project Two may be a factor in the lack of robustness of the process model adopted by the group. Further research should address more formally the nature of the dialogue that occurs when using a GSS of this type, and how dialogue differs between supported and unsupported groups. Such research could involve the recording and analysis of conversations in meetings supported by a GSS, the measurement of microscopic process variables, and the investigation of patterns of communication and influence between participants.
5. Further research should also consider an investigation into the effects of intervening through a GSS into existing group processes and practices in a field based situation. The existing (pre-GSS) group process could be recorded and analysed. The effects of using a GSS with the group (in terms of both process and outcomes) could then be analysed and compared with the pre-GSS meeting analysis.

As has been identified in this portfolio, we are still in the early stages of GSS research, and the inconsistent results obtained from experimental studies, especially when compared to field studies, means that there is still much to investigate concerning the

effectiveness and evaluation of group support systems. The evaluation of a Group Support System depends upon each of the three different evaluation methods identified, but in a field situation each of the three methods may not always be available. There is likely to always be a degree of subjectivity in the evaluation of a Group Support System in a particular context.

This portfolio of work is one contribution to this field which, together with current and future research on the application and evaluation of GSS, should enable us to better answer the question posed by Finlay (1998:200): that is that GSS research should attempt to *“articulate understanding to answer the question: What is the appropriate support for a group in the context it finds itself?”*

CHAPTER TWO

PROJECT ONE

DEVELOPMENT AND APPLICATIONS OF A GROUP SUPPORT SYSTEM

9 Introduction to Project One

Information Technology (IT) is now accepted as an aid in virtually all processes in organisations. Most manufacturing processes make use of IT systems for design and control purposes, routine transactions are supported by Transaction Processing Systems, managers use Management Information Systems to plan and control activities and resources, and Decision Support Systems help managers understand the possible consequences of different strategies.

One area where Information Technology has not yet had such a large impact is in supporting groups and meetings. For example, many organisational decisions are made by groups of people. A fundamental question for researchers in both the IT and decision support fields is therefore concerned with whether IT could have a more significant role to play in supporting organisational groups meeting for some purpose.

There are a number of examples identified in the Literature Review where Information Technology has been directly used to support the process by which a group of people make a decision. When used in this way, the IT system is often known as a Group Decision Support System (GDSS). However this concept has been extended to tasks other than decision making, and IT systems used to support groups are now commonly known as Group Support Systems (GSS), although other terms are sometimes applied such as Group Process Support System, Electronic Meeting System and Electronic Meeting Aid. In common with other researchers (e.g. Nunamaker *et al*, 1997; Pervan, 1998; Briggs *et al*, 1998b), this portfolio refers to IT systems of this kind as Group Support Systems (GSS).

The Literature Review identifies the theoretical underpinning of Group Support Systems. By providing a further, and to a variable extent anonymous, channel of communication within the group (over and above face to face interaction), it is argued that group process losses such as domination, conformity and polarisation can be reduced, dialogue between the participants can be improved, and a more effective group process will result.

Appendix A identifies some well-known Group Support Systems developed both by academic and commercial organisations. The majority of literature devoted to GSS tends to involve the networked personal computer approach, as exemplified by the GroupSystems GSS; see for example Pervan (1998:155). In the decision room approach, such a system requires a number of personal computers networked together in the decision room. If a dedicated decision room that contains the technology is not available, the setting up of the system is a relatively large task. A further issue is that networked personal computers essentially alter the communication channels in the meeting, with much of the communication based upon typed messages using the computer and not face-to-face dialogue.

I have been directly involved in the development of GSS, known as Teamworker, over a 15 year time period from 1988 to the present time. These developments have normally involved collaborations with other researchers, notably Professor Tony Gear, but also others particularly in the organisations where the Teamworker system has been implemented. My personal involvement has included the design and development of software, the design of hardware, the design of social processes that make use of the Teamworker system in organisational contexts, the application of Teamworker within organisations, and the analysis of the outputs of group sessions involving Teamworker.

The Teamworker GSS is not based upon networked personal computers, but on individual handsets that can send numeric information to a personal computer. Such a system is extremely easy to set up in any room (it can typically be set up within 15 minutes). As well as support for the group process and task, an essential purpose of the Teamworker GSS is to provide cues for face-to-face dialogue and discussion which will enable shared meaning and the development of new and aligned actions (Dixon, 1999:136). To support this face-to-face dialogue, I believe that such a system should be unobtrusive (i.e. make use of low impact technology).

This project considers the development and implementation of the Teamworker GSS over this 15 year time period, and reviews many of the Teamworker applications that have been reported in the academic literature, business journals and newspapers. The lessons learnt through these applications have enabled the development of a GSS

Design Framework and the derivation of GSS Design Guidelines that can help focus the design of the Teamworker GSS in varied settings.

9.1 Objectives of Project One

1. Using an Action Research approach, discuss the development and implementation of the Teamworker GSS over a 15-year period, including the hardware and software developed over this period.
2. Review nine Teamworker applications that have been reported in the academic literature, business journals and newspapers, using a series of case study ‘vignettes’.
3. On the basis of the development and applications of the GSS, develop GSS frameworks and design guidelines that can aid the development and implementation of Teamworker applications.
4. Discuss the perceived value of the GSS through the applications reported in this project, and how these applications reflect GSS academic literature

10 Development of a Group Support System

Some years ago, in the late 1980's, I was involved in the organisation and operation of Military Judgement Panels (MJPs); see Defence Evaluation and Research Agency Report (2000) for further information on Military Judgement Panels. These panels are made up of military personnel, and their role is to consider the likely effectiveness of future weapons systems. The outputs of Military Judgement Panels are an important aspect in the decision whether to spend millions of pounds on a particular new weapons system. However, there appeared to be a number of problems with the operation of these MJPs, including:

- Much of the discussions appeared to be dominated by officers of higher rank.

- The processing of data and feedback to the group often resulted in improved understanding of both the problem and the process. However, the period of time between collection of data and the processing into results (sometimes days, sometimes longer) caused some difficulties in taking advantage of this improvement in understanding.

At around the same time, a first development of a hard-wired system of handsets to enable a decision-making group to review feedback of its feelings in relation to progress on the task was developed and used (Gear *et al*, 1985). Following discussions with Dr Tony Gear, we conceived of an IT based system that would support a group such as a Military Judgement Panel. The system would be based on a number of handsets that would enable members of a group to anonymously enter their opinions and judgements in numerical form into a computer running suitable software. The individual inputs would be processed by the software, and the processed information would be immediately fed back to the group in a suitable form for discussion and debate. The system would need to be unobtrusive (or 'low impact'), would encourage dialogue, and would not infringe on the normal group process. At that time, we did not know of any system available that would meet these requirements, therefore we resolved to develop a system ourselves. This system became known as the Teamworker Group Support System.

The Teamworker system comprises a set of individual handsets (each with a numeric keypad, a 2 line LCD display and radio transmitter) with which opinions and judgements can be sent in digital form to a radio receiver. The receiver is connected to a personal computer running suitable group support software. The personal computer is linked, via a video projector, to a large group screen that can be viewed by all members of the group (see Figure 9). This large group screen is used to both display questions to be answered and display back processed summaries of the group responses.

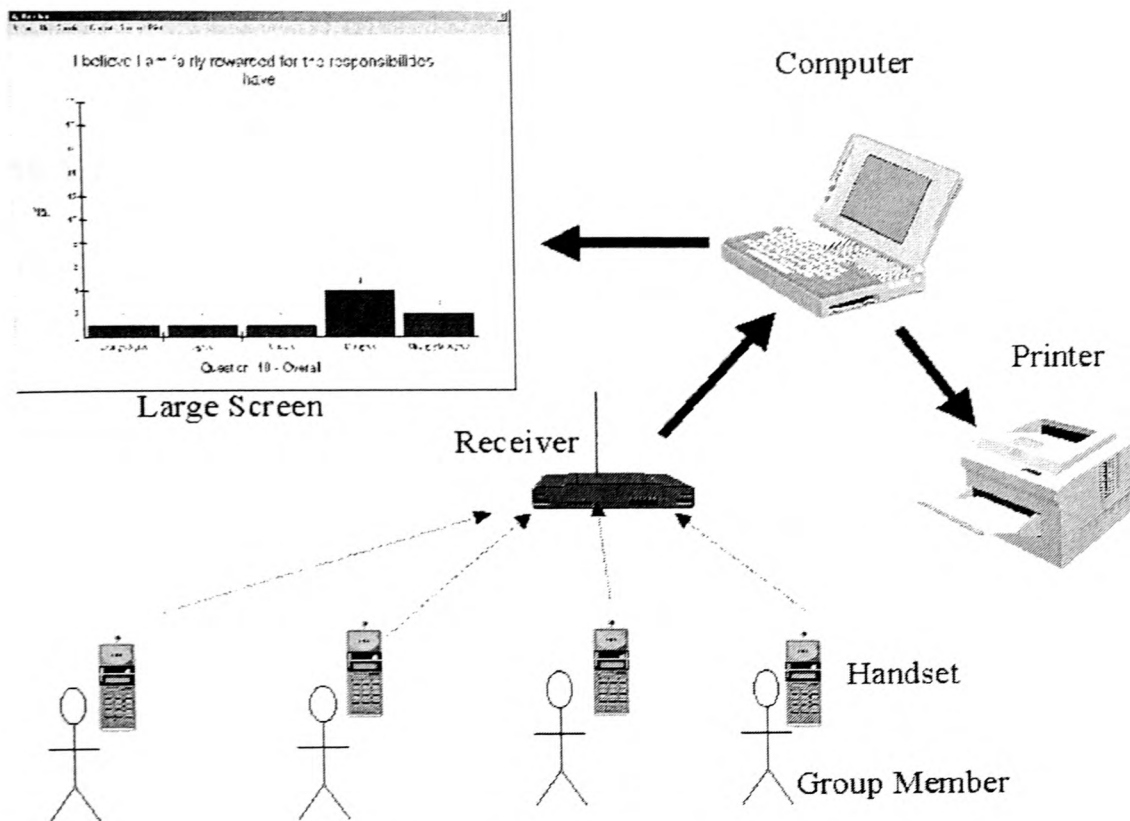


Figure 9: The Teamworker Group Support System

10.1 Communication Media

The Teamworker GSS, as shown in Figure 9, had to be developed 'from scratch'; in 1988 there were no easily available handsets that could simply be hooked up to a personal computer. Therefore consideration had to be given to the type of communication medium that would be used to enable the handsets to be able to send messages to a personal computer. Three different communication media were considered:

- Hard wired (i.e. cable)
- Infra red
- Radio

Teamworker versions were developed for each of these types of communication media. For each communication media, electronic engineers were employed to develop the

handset technology and protocols to enable the system identified in Figure 9 to be constructed. Issues with each of the communication media are briefly described below.

10.1.1 Hard Wired System

This was the cheapest version to develop, and comprised a set of handsets hard wired (using a token ring technology and co-axial cable) to a receiver box that was directly connected to the serial port (RS232 port) of a personal computer. However, initial trials identified the following problems:

- It took a relatively long time to set up in a decision room, as each of the cables had to be individually plugged together to form the 'ring'.
- It was not unobtrusive, which was one of the principal design requirements. The cables would have to be hidden under safety mats to ensure that no one would trip over the cables. This was viewed negatively by managers in initial trials.

It was therefore decided that a hard-wired system was not feasible, in terms of the required design consideration that the system be unobtrusive, or low impact.

10.1.2 Infrared

This is also a relatively cheap option, as infrared transmitters and receivers can be purchased very cheaply. The Teamworker infrared system comprised a set of handsets, each with an infrared transmitter, and an infrared receiver box linked to a personal computer through the serial port (RS232 port). However, initial trials identified an issue of reliability. Unless there was a direct line of sight between the handset transmitter and the infrared receiver box, the messages would not be reliably picked up by receiver box. It was felt that this would be too frustrating for managers in an organisational setting, and therefore it was decided that this option was also not feasible.

10.1.3 Radio

This is the most expensive option, and also the most complex, as radio is a 'slower' medium than both infrared and cable, is more prone to 'clashing signals', and is also regulated by the Department of Trade and Industry. However, when compared to hard-

wired systems, radio systems are far less obtrusive (and are therefore lower impact), and when compared to infrared systems, radio systems are more reliable. It was therefore decided that the Teamworker GSS should be based upon radio technology.

10.2 Software

Software to support the groups using the Teamworker GSS also had to be developed from scratch. The earliest software was developed using Microsoft QuickBasic in an MS-DOS operating system environment. This early software had to be developed to enable the Teamworker GSS to be easy to use, but also to demonstrate the possible ways in which Teamworker could support groups. The initial software contained a decision analytic model based upon the Analytic Hierarchy Process (AHP) decomposition method (Saaty, 1977).

When discussing possible ways in which the Teamworker GSS might be used with groups, it quickly became clear that various types of process would be involved, and that different groups would require different types of feedback. Therefore for many applications, software would need to be specifically written to reflect the task and group process of particular groups, rather than using some generic software that could deal with all tasks and group processes. This point is highlighted in the Field Applications discussed in Section 11 of this project.

10.3 The Completed Teamworker GSS

Despite 15 years of development, the Teamworker GSS has not been completed. New ways in which the system might prove useful to groups are still being developed, and therefore the system will need to be further developed to enable these new applications to be implemented. However, a hardware system, based on radio telemetry, has been successfully developed, and software to support different tasks and group processes, and implemented within organisations has been completed.

Figure 10 shows a photograph of a typical Teamworker handset. As can be seen from this photograph, the handset comprises a numeric keypad and a display – it is extremely easy to use. A number of output feedback screens from the various pieces of software

used to support the field applications reviewed in Section 11 of this project are contained in Appendix C.



Figure 10: Teamworker Handset

As part of this project, the Teamworker GSS (hardware and software) is also presented as a completed artefact, and is available for review and experimentation.

10.4 Academic, Business Journal and Newspaper Articles

A number of published academic articles, business articles and newspaper articles that review, describe and analyse the use of the Teamworker GSS have been written. Where relevant, these are referenced in each of the field applications reviewed in Section 11. Appendix B contains the full references of all the published academic articles where I have been directly involved.

11 Field Applications

This section presents in brief nine applications of the Teamworker GSS. Each application is described under the headings of background (e.g. context and task), process model (e.g. GSS support and how it was used in the group process) and experience (e.g. GSS user experiences). The current situation with each application and papers and articles that refer to the application are also identified

The applications concern groups in organisations engaged in strategic as well as routine tasks, and also of 'recurring' tasks and 'once only' tasks. In each application, a suitable

process and supporting model was designed and developed as each application group was identified as having different requirements. It is not feasible to have all possible group requirements in terms of process support to be built into a single piece of software – the software will need to be individually designed for the group, the task it is involved in and the process support that is necessary.

11.1 SmithKline Beecham - Portfolio Selection in Commercial Research and Development

11.1.1 Background

This organisation is SmithKline Beecham plc, a multinational pharmaceutical organisation with R&D laboratories collaborating with each other but based at sites across Europe and North America. The group task is concerned with the selection of a preferred portfolio of projects to which to allocate scarce resources, especially manpower.

A number of factors are taken into account in this process, including market potential, competition, stage in development, chances of technical success, therapeutic area balance, long and short term returns, resource constraints and resource availabilities. A series of meetings is held each year to decide the portfolio, and other review meetings are called at other times to decide changes.

11.1.2 Process Model

The GSS was used by committees within each therapeutic area team (TAT), and the outcomes of these meetings were used as inputs to subsequent meetings of a more senior development committee. Rank-ordered lists were produced within each area under headings of 'early stage' and 'near market projects'. These were considered in terms of various commercial and technical criteria as well as other factors and information. The development committee produced overall rank-ordered lists for the two project categories, and from these an overall prioritised list. Resource constraints and issues of portfolio balance were considered in order to decide the preferred portfolio. The software was designed to facilitate a variety of processes, especially scoring on criteria and voting on issues. At every stage the software enabled displays of

differences of opinion to be debated and changes to be made so that the group was able to progress flexibly with many interactions (see Appendix C for some of the feedback screens developed for this application).

11.1.3 Experience

The whole process was spread over several weeks and involved a number of linked meetings. Most of the time there was a high level of agreement, but at certain points there was great disagreement, and much debate and repeat inputting. During the meetings there were a small number of occasions when fundamental and important disagreements persisted and there was not even a simple majority position. The chair then focussed debate on isolating whether the differences related to 'factual' information or assumptions or to fundamental values. In most cases a consensus emerged at these points, however on some occasions the chair (who carried the ultimate responsibility) took a finely balanced judgement that did not conform to the majority viewpoint.

The use of the system in this context was positively viewed by many of the participants. The Director and Senior Vice-President of Project Management (John Dent) at SmithKline Beecham stated that:

It is possible to take a vote at the beginning of a discussion to gauge the feeling of the meeting on an issue. That pinpoints whether you need to discuss it more. It facilitates the process of debate and rapidly ensures you get to a clear cut decision... it is a very useful tool for facilitating appropriate discussion and ensuring that you spend time dealing with things that need to be discussed rather than on things that are foregone conclusions

(Executive Strategy, 1991).

He also noted that the time taken in meetings was substantially decreased, domination effects were reduced through using the system and that all participants had the opportunity to register their view (Arnold, 1993; Hill, 1994). However, John Dent could not say that better decisions had been produced through using the system, but identified that:

...everybody understands what decision has been made. People who disagree have had the chance to be heard and persuade the others.

(Executive Strategy, 1991).

A participant in the process, Leanne Wagner, the Head of Gastrointestinal R&D, commenting on the process, argued:

Social pressures is considerably diminished; participants can disagree without confrontation producing a more honest spread of opinion. It becomes much more difficult for a senior member to dominate the meeting

(Arnold, 1993).

Richard Thompson, another SmithKline Beecham member of staff who has been a participant in meetings supported by Teamworker, has said:

The system greatly stimulates debate in a positive and non-threatening way, enhancing both individual understanding and group development

(Thompson, 1995).

11.1.4 Current Situation

The Teamworker GSS was used as a decision making tool for around two years. Thereafter it was adopted as a training support tool but its use was discontinued as a support for R&D portfolio selection. This followed an organisational change, where personnel involved with introducing the GSS, including John Dent moved to other positions.

This application of the Teamworker GSS has been described in both the academic literature (Gear and Read, 1991; Read and Gear, 1999) and also in business journals and newspapers (Executive Strategy, Autumn 1991; Accounting for Technology, January 1994; the Financial Times, 2nd February 1993).

11.2 UK Ministry of Defence - Option Selection in Defence Systems

11.2.1 Background

The organisation is the Defence Operational Analysis Establishment (DOAE) which was concerned with providing Operational Analysis advice to the UK Ministry of Defence in respect of current and future defence systems. A set of seven options had been identified for a military system to meet a well-defined threat. A considerable amount of experimental and simulation data was available. The criteria by which to judge the options were pre-defined.

11.2.2 Process Model

As a means of exploring further the relative merits of the options, a group of twelve military experts was assembled for a one-day meeting. The options were considered on each of the criteria in turn. Each participant was asked to define and anchor the end points of rating scales with their personal (and at this stage, confidential) highest and lowest rated options on each of the given criteria. Following this, the group entered their personal ratings on each option for each of the criteria taken in turn. As each set of inputs was completed, they were immediately displayed back to the group for discussion. During these debates, re-definition of some of the criteria took place, and/or the number of criteria changed. Sometimes the ratings were repeated as a result of this or other debates.

The relative importance of the criteria themselves was then considered using a constant sum method. The criteria were taken in pairs and 100 points allocated between the pairs by each participant without prior discussion (see Cleland and Kocaoglu, 1981:326, for description of 'constant sum' method). They were asked to allocate these points according to the 'swing weights' definition of relative importance (see, for example, Watson and Buede, 1987:201). When all pair-wise comparisons were completed, the importance weights were displayed as values and rankings tables across the set of criteria and participants. This generated discussion and a re-weighting of the criteria. Finally, an 'overall' result for each individual was displayed by calculating a summation of the scores multiplied by the weights for each option over the criteria set. Differences at this stage generated further debate. An exploration of the sensitivity to change of

these results was presented on-line by changing first the scores and then the weights. In a final debate the option preferred by the group overall was selected by consensus.

11.2.3 Experience

The participants appeared very happy with the process, especially the frequent opportunities to debate well-focussed issues. The meeting was considered effective by all the participants, and further meetings concerned with other issues were later held. An independent report on the use of Teamworker at this meeting was prepared by the Centre for Operational Research and Defence Analysis (CORDA), a defence consultancy and part of the Yard Group. The conclusions from this report say that, *“the trial of Teamworker proved very successful....all parties present (at the meeting) responded positively to the system”* (Yard Report, 1990). Additionally, Stewart Kempster, senior manager at CORDA felt that the system *“provides the structure you should have anyway and modifies the impact of the vociferous person”* (Cherfas, 1990).

Dr Roger Allen, a scientist involved in using the Teamworker system at DOAE stated:

The use of Teamworker enables us and our sponsors to examine potentially contentious issues in a methodical and transparent manner, producing acceptable quantifications of ‘quality’ and ‘policy’ factors for use in decision-making

(Allen, 1992)

Following this trial, the Defence Operational Analysis Establishment (DOAE) adopted the Teamworker GSS for a number of judgemental panels. It was found to be especially useful in conjunction with Mission Orientated Analysis (MOA), a modelling technique for decomposing the capabilities of defence systems into tactical and strategic aspects in a hierarchical manner, allowing each of the elements to be individually assessed (see Coyle, 1989). Appendix C contains two feedback screens developed to support the MOA framework.

11.2.4 Current Situation

The Teamworker GSS was used as a decision making tool by DOAE (later known as Defence Evaluation Research Agency, DERA) for around five years. Its use was discontinued following personnel changes.

The use of the Teamworker GSS within the defence environment has been reported in the academic literature (Gear and Read, 1991), newspapers and magazines (Focus, 4th March 1993; Science, 19th October 1990) and through an independent report (Yard Report, 1990).

11.3 US Based Multinational Oil Corporation - Long Range Strategic Planning

11.3.1 Background

The organisation is the research arm of a large US based multinational oil and petroleum products company. The organisation was concerned to ensure that it was making good decisions regarding technologies intended for commercial introduction and application on 10 to 30 year future time frames. This is part of a continuing process led by an internal 'Core Team' involving the study of two key aspects:

1. Business Drivers – i.e. trends culminating in opportunities or threats to the organisation (including consideration of social, technological, political, cultural and environmental issues);
2. Business Options – i.e. a set of projected capabilities which would enable implementation of a specific technology for a defined business purpose at some future time.

The Core Team comprises senior members from both the scientific and business areas of the organisation. The organisation decided that part of this continuing process would be a three day workshop involving senior executives from the R&D function and from a cross-section of other business functions. A total of 42 senior executives took part in the workshop, 30 from the R&D function and 12 from other business areas.

The purpose of the workshop was to exchange views and pool judgements relating to the business options being considered by the organisation, and to provide guidance to the Core Team on the high grade options, the options to drop, and the options requiring further work. It was stressed that this workshop was not so much a decision-making forum, but rather an opportunity to exchange views, evaluate and grade options.

11.3.2 Process Model

Prior to the workshop, a long list of business drivers was developed by the Core Team, and a report on each of these business drivers was presented to the workshop and discussed. This provided a framework for the subsequent assessment of the business options. These business drivers were then scored by the workshop participants using the Teamworker GSS, to identify the high priority business drivers from the viewpoint of the workshop participants. This scoring was undertaken using a 1 to 5 scale (where 5 was considered a high priority business driver, and 1 a low priority business driver). Graphical screens showing the bar chart of scores was fed back to the workshop participants after scoring of each business driver for additional discussion and re-scoring where the workshop felt it necessary.

Following this, a list of 35 possible business options, specified in terms of the business drivers, was presented to the workshop participants. The objective of the workshop was to identify a short list of important business options, and this was achieved using a two stage process.

1. The *Screening* process involved creating a short list of 12 business options (from the original 35 business options) through an assessment of the business importance of each business option, from the viewpoint of the workshop delegates. This involved the scoring of each business option using the Teamworker GSS, again using a 1 to 5 scoring scale. Graphical screens showing the bar chart of scores was fed back to the workshop participants after scoring of each business option for additional discussion and re-scoring where the workshop felt it necessary. Differences between the 'scientific' and 'business' communities were also highlighted and this created additional

discussion. Mean scores and standard errors of scores were captured through this Screening process, and the mean scores were used to rank each of the business options. The ranked business options were presented to the workshop delegates in the form of a 'high-low' chart, showing mean scores and standard errors for each business option. This chart included the identification of a 'grey area' which depicted the zone where the cut-off for the short list of business options to be studied further was located. Further discussion concentrated on this grey area, with some re-scoring of options by the workshop participants. The outcome of the Screening process was a defined shortlist of 12 business options considered of most importance to the organisation.

2. The *Mapping* process was used to further investigate the shortlisted 12 business options. The workshop participants were divided into 12 work teams, each to develop one of the selected shortlist options. Each team spent a day developing the advantages and disadvantages of the relevant business option. These were then presented to the rest of the workshop participants, and the workshop participants then scored each of the short listed business options on two criteria - *relative likelihood* that the option would be feasible in the given timescale and the *relative impact* the option would have on the organisation if it were feasible. A 1 to 5 scale was again used for scoring on each criterion. Graphical screens of bar charts and grids showing the scores on the two criteria were fed back to the workshop participants for discussion and re-scoring where necessary. The important business options to develop further by the organisation were those identified with a relatively high score on both criteria.

Group feedback screens developed for this application are contained in Appendix C.

11.3.3 Experience

The three day process was undertaken without overt facilitation in order that no 'external influences' were present in the group to distort or bias results. On completion, the participants were very pleased with the process in terms of opportunities to both enter their judgements using the Teamworker handsets and to express their opinions during focussed discussions. The Core Team were provided with clear information in

terms of the areas requiring further attention by the organisation. The project manager of the workshop event (and Core Team member) stated:

"We couldn't have had that event without the Teamworker GSS. We might have had some other, more conventional, meeting but I don't think it would have been nearly as productive"

(Read *et al*, 1994).

11.3.4 Current Situation

This was a one off special event. However, the Teamworker GSS was not used again by oil corporation, despite the perceived success of this event. A reason given by the organisation was the difficulties in collaborating with UK based researchers.

This application has also been reported in the academic literature (Gear and Read, 1991; Read *et al*, 1994), and also in the Accounting for Technology Magazine, January 1994.

11.4 Pharmaceutical University-Based Professional Education

11.4.1 Background

This situation involved undergraduate teaching in the Departments of Pharmacy at the University of Manchester and the University of Portsmouth. The need was to ensure the development of professional skills when dealing with patients, and in accurate prescribing of appropriate drugs or medication for a given condition. This involved the relationship with the patient in order to make a proper diagnosis and prescription decision.

11.4.2 Process Model

A video training film is shown on a large screen simulating a patient-pharmacist interaction. Sometime the film is commercially available, other times it has been produced by the students themselves. The video film is paused at appropriate points in a series of sequences of dialogue between the patient and the pharmacist. The same

large screen then displays an appropriate question and set of alternative answers (see Appendix C).

The students respond with the Teamworker GSS handsets, either individually, or in groups of up to four. Bar charts of the responses received are displayed on the screen so that the lecturer concerned can easily run a discussion based on the range of answers. The next video clip is then displayed, and so on.

11.4.3 Experience

The system has been very well received by both lecturers and students at both universities. Lecturers working with the system have noted a greatly increased level of attention, interest and preparedness to participate in classroom debate from the students. When the students formed small teams to a single handset, a spirit of competition between the teams was generated. This meant that 'within team' discussion as well as plenary discussion took place, enhancing mutual learning.

Alan Kensley, Interactive Video and Learning Technician at the University of Manchester, stated:

One advantage is that answers are given anonymously, so students don't feel the need to conform to what everyone else is saying. With the handsets you respond personally, without pressure. Something else we've found is that attendance levels are far higher when we are using Teamworker. They all turn up! The students do seem to like it. Obviously there is a certain novelty value attached, but that doesn't seem to wear off

(Gerrard, 1994).

Dr Adrian Hunt, Principal Lecturer in the Department of Pharmacy at the University of Portsmouth stated:

We have surveyed students and had very positive feedback about the system. They liked the fact that they can see how well they've done in relation to others, and

can have problems dealt with immediately – rather than after the work has been handed in

(Pugmire, 2000).

11.4.4 Current Situation

The Teamworker GSS continues to be regularly used to support pharmaceutical university-based professional education without any additional support of the researchers.

Applications of the use of the Teamworker GSS in pharmacy education have been reported in the academic literature (Gear and Read, 1991) and have also been reported in newspapers (The Guardian, 24th February 1994; The News, 12th January 2000). Read *et al* (1999) contains details of additional experimentation using the Teamworker GSS in university education (funded by the University of Portsmouth).

11.5 Carlsberg-Tetley – Panel Testing and Tasting

11.5.1 Background

Carlsberg-Tetley is a major brewer with a large range of beers and lagers at a number of dispersed sites. Production is tasted and tested by panels of experts on a daily basis. The objective is to identify, for each branded product, deviations in either direction from a defined product profile. The profile is based on 35 dimensions (criteria) related to identifiable aspects of taste, appearance and smell.

11.5.2 Process Model

It was important to allow each participant to respond during the tasting process in his/her own time, and by exception. A scoring scale with allowance for positive or negative deviations from a correct (zero) profile for each beer (on the 35 criteria) was already in use and very familiar. This scale was incorporated into the software. The screen was sectorised for responses from particular numbered handsets. On completion of the inputs on each of typically eight beers, the values were displayed back to the panel in a bar chart form for each beer on each dimension (see Appendix C for a typical

feedback screen developed for this application). Where significant differences of opinion were observed they were discussed. The participants sometimes re-tasted and re-scored at these points.

11.5.3 Experience

The process was fast and delivered timely outputs for discussion during tastings, and was adopted for both actual tasting sessions and for training purposes. The system was seen as especially helpful in training new beer tasters, as discussions on differences of opinion on a particular tasting criterion could take place in a non-threatening environment, and also for identifying where beer tasters were not so good in identifying particular tasting criteria. In a newspaper article (Gerrard, 1994) Neville Swales, Carlsberg-Tetley Technical Administrator, identified the following advantages:

1. Automatic data collection – the whole process is faster, in that data is collected automatically rather than having to be manually entered into a computer.
2. Ability to discuss differences of opinion during the tasting sessions – the summary output screens are shown back to the tasting panel, and enable focused discussion on differences of opinion.

11.5.4 Current Situation

The Teamworker GSS to support this application was discontinued after a period of one year, mainly because of technical difficulties caused by the requirement to make the handsets 'beer proof'. Optical scanner technologies replaced the Teamworker GSS, although this method did not allow immediate discussion of differences of opinion. Neville Swales felt that the process using the GSS had been superior, but the technology was not robust enough.

This application of the use of the Teamworker GSS in panel testing has been reported in the academic literature (Gear and Read, 1991) and also in a national newspaper (The Guardian, 24/2/94).

11.6 Bayer PLC – Developing Action Plans

11.6.1 Background

The organisation is a major multinational pharmaceutical organisation. A product team within the organisation was concerned to review and to develop action plans to improve the competitive position of a major drug within its portfolio of products. The drug was a synthetic derivative with an anti-bacterial activity to a wide range of organisms found in the respiratory tract and intestines: it was normally presented as a tablet or solution administered orally or by injection.

11.6.2 Process Model

The product team that considered the competitive position of the drug was comprised of seven senior staff, three from technical functions and four from commercial functions. An initial list of 26 possible activities, known as sub-projects, was generated in preparation for the meeting. These sub-projects concerned different indications of the drug with feasible formulations (i.e. methods of application of the drug which show commercial or technical promise), and were put forward by staff working in each application area of the drug. The meeting lasted a day, and involved:

1. Refining the list of sub-projects and the criteria with which to judge the sub-projects (Technical Features and Commercial Promise, each of which were further refined into sub-criteria).
2. Scoring each of the sub-projects using a 1 to 9 scale on each of the two criteria, where sub-projects rated 1 showed the least promise, and options rated 9 showed the most promise. Summary feedback bar charts of scores were displayed back to the group for discussion and re-scoring where necessary.
3. Identification of sub-projects requiring more consideration, which were then scored and discussed at the sub-criteria level.
4. On the basis of the scoring and subsequent discussions, the identification of the highest priority sub-projects using a 1 to 3 scale, where 1 identified the lowest priority sub-projects and 3 identified the highest priority sub-projects.
5. Development of action plans for highest priority sub-projects.

11.6.3 Experience

The meeting lasted the full day, and all the members of the group were fully involved in the discussions and scoring throughout. The Teamworker software for this application had been pre-programmed to allow a number of different types of summary screens to be shown flexibly. During the meeting, the participants asked that the scores be summarised in different ways (e.g. bar charts, two dimensional grids showing participant and average scores on any two criteria and ranked lists – see Appendix C for feedback screens developed for this application); each of the different summary screens enabled further discussion on the differences of opinion within the group.

11.6.4 Current Situation

The event discussed in this section was perceived a success, and Bayer plc supported the publication of an article describing the case study (Gear *et al*, 1999). However, the manager responsible for introducing the system left the organisation and Bayer did not use the system again.

11.7 Northamptonshire County Council – Validation of a Client Assessment Model

11.7.1 Background

Project Three of this portfolio analyses the application of the Teamworker GSS to support the training of Norwegian social services personnel in the use of a standardised framework known as Gerix, which is used for the assessment of social services clients. An outcome of this project is that the training team identified deficiencies and ambiguities in the description of the framework that led to inconsistent interpretations by professionals required to use the model. This outcome motivated the application described here. The application took place in the Social Services Department of Northamptonshire County Council (NCC) and involved staff concerned with client assessment from Care Management Services. Care Management Services has approximately 150 staff targeting the adult population. There are four community and two hospital-based teams who respond to around fifty to sixty referrals per day.

NCC is concerned to allocate its scarce resources to those in greatest need or at greatest risk, and has developed a model to aid client needs assessment, known as the Prioritisation Matrix. The model has been designed to assist staff to make consistent judgements regarding welfare provision in response to referrals for service and takes the form of a two dimensional matrix with 'needs' and 'risk' as the dimensions. The matrix defines incremental levels of need and risk against pre-defined standards, in terms of required resources and time-scales. Having developed the model, NCC were concerned to identify whether the Prioritisation Matrix could be interpreted consistently by professionals who were required to use it, and decided to run a number of group sessions, supported by the Teamworker GSS, to assess this aspect of the model.

11.7.2 Process Model

Three separate meetings were arranged, each involving five Principal Care Managers concerned with client assessment, and an independent facilitator was used to support the task. The objectives of the meetings were:

1. To use the Teamworker GSS to investigate the validity of the Prioritisation Matrix in terms of the consistency with which each meeting was able to assess a set of cases, each based on client data.
2. To identify the reasons for any differences of judgemental assessment of these cases, in terms of pin pointed weaknesses of the matrix which might require further structural or definitional attention.

The meeting process was developed to ensure many opportunities for discussion, focussing on displayed differences of opinion. Six selected client cases were used to test the model. Having read the notes of a client, the group participants used the Teamworker handsets to assess the client in terms of the Prioritisation Matrix levels of 'need' and 'urgency'. Following these initial assessments, discussion of differences and re-assessment where considered necessary by the group, the final assessment distributions were displayed for each individual cell of the Prioritisation Matrix (see Appendix C for feedback screens developed for this application). At this stage discussion was supported by expert opinion for each specific case.

11.7.3 Experience

During the process, significant differences of opinion could be observed, both between the group participants and also with the ‘expert assessment’. During the ensuing debate the reasons for these differences of opinion became clear – they were largely the result of inconsistencies within the Prioritisation Matrix. Conclusions regarding these inconsistencies were reinforced by the fact that the reasons for differences were largely shared by all three sessions. A number of issues regarding the Prioritisation Matrix were raised. Examples of these include:

1. Staff were more consistent in their responses to the ‘urgency’ axis than to the ‘need’ axis. This they saw as due to definition and semantic problems and also ambiguities about the focus of assessment – e.g. were they to consider absolute need or current, residual need?
2. Staff believed that the matrix required ‘fine tuning’ around the prescriptive staff levels and also that there were inconsistencies within the time scales at different levels of ‘need’ and ‘urgency’ interactions.

Eight evaluative questions, in terms of the group sessions and the process support, were also asked of each participant in the group, and the results of these are shown in Table 3.

| Questions | Strongly agree | Agree | Disagree | Strongly disagree |
|--|----------------|-------|----------|-------------------|
| 1. The venue was good | 1 | 10 | 3 | 1 |
| 2. The case material was good | 2 | 12 | 1 | 0 |
| 3. I was happy with the process | 8 | 7 | 0 | 0 |
| 4. The software performed well | 5 | 10 | 0 | 0 |
| 5. The hardware performed well | 8 | 7 | 0 | 0 |
| 6. The facilitator did a good job | 6 | 9 | 0 | 0 |
| 7. The quality of learning was high | 3 | 11 | 1 | 0 |
| 8. The session was relevant to my work | 7 | 6 | 2 | 0 |

Table 3: Results of the evaluation questions, summed over the three sessions

In general, the participants were positive about the sessions, for example all 15 participants were happy with the process and 14 participants felt that the quality of learning was high.

11.7.4 Current Situation

The event discussed in this section was perceived a success and led to modifications in the Prioritisation Matrix. However, the system was not used again by Northamptonshire County Council following organisational changes and budgetary pressures.

Further details of this application are reported in Read *et al* (2000b).

11.8 Engineering and Physical Sciences Research Council (EPSRC) - Funding of Technology Research Areas

11.8.1 Background

This application concerns using the Teamworker GSS in a government funded research council, the Engineering and Physical Sciences Research Council (EPSRC), to determine whether future funding of a number of important technology areas should be held at present levels, increased above current funding or reduced below current funding, given the overall funding limits imposed on the research council by Central Government. As with organisation considered in Project 2, advice is given by a peer group committee of relevant experts in the general subject area. In this application the peer group committee used the Teamworker GSS to support the process of preparing its advice to the research council.

The task of the peer group committee involved advising which technologies should have increased funding, reduced funding, or funding continuing at the current level. The committee, which comprised 12 experts, was asked to prepare advice on 14 separate technology areas. This advice had to be prepared in the day dedicated to this task at the peer group committee meeting. Prior to the meeting, the committee members had been sent relevant papers concerning each of the technology areas, and had been asked to score each of the technology areas on a number of criteria using a set of pre-defined scales that had been carefully selected for the purpose.

11.8.2 Process Model

A decision aiding framework and process protocol was developed jointly by myself, Professor Gear and EPSRC, using an action research approach. Associated Teamworker software was designed and developed by myself. The research council had previously developed five major criteria with which to judge technology areas, and each of these five criteria were further divided, making a total of 17 criteria. A 1 (low) to 5 (high) interval scale was used to score each technology area on each sub-criterion, where each point on the scale was uniquely identified with a text description for each of the 17 sub-criteria.

The committee meeting followed a two stage process.

Stage 1 – Initial Consideration of Technology Areas

Prior to the meeting, each expert was asked to score each technology area on each of the sub-criteria using the 1 to 5 interval scales. This information was fed into the Teamworker software prior to the meeting. At the meeting itself, a number of feedback screens were available for the committee on request, including:

1. Bar charts for each technology area scored on each sub-criterion, showing the range of scores, the average and standard deviation.
2. Layered bar charts showing the averages and standard deviations of all technology areas for a single sub-criterion.
3. Layered bar charts showing the averages and standard deviations of a single technology area across all sub-criteria.
4. A stacked bar chart showing the aggregate average scores of all technology areas for each of the five major criteria.
5. Ranked lists of technology areas on each of the sub-criteria, the five major criteria and the aggregate total.

Appendix C shows the feedback screens developed for this application. The committee members reviewed the various graphical feedback and discussed differences of opinion.

Where necessary, technology areas were re-scored on selected criteria using the Teamworker handsets. This exercise enabled all committee members to exchange information and views concerning the relative benefits of each technology area. In practice, the committee mainly utilised the feedback items (1) and (3) in the list above.

Stage 2 – Holistic Scoring of Technology Areas

The committee members then continued by holistically scoring each technology area using the Teamworker handsets and the following scale:

- : Reduce current funding level
- 0 : Maintain current funding level
- + : Increase current funding level

Bar charts showing the range of scores for each technology area were available to the committee for discussion and re-scoring where necessary. Finally, a summary chart was presented to the committee displaying, in rank order, the total number of increased funding (+) and reduced funding (-) scores for each of the technology areas. This was discussed, and it was agreed by the committee that this would form the basis upon which advice would be given to the EPSRC regarding future funding of technology areas.

11.8.3 Experience

The process enabled the clear identification of the priority technology areas where the committee felt that funding should be increased, and also those technology areas where funding should be reduced. The committee members appeared happy with the process, and felt that the Teamworker system was easy to use.

11.8.4 Current Situation

The event discussed in this section was perceived a success, and the EPSRC requested further use of the system. However, EPSRC also required changes to the system software which were not feasible to implement at that time therefore EPSRC did not use the Teamworker GSS again.

Further details of this application are reported in Gear *et al* (1996).

11.9 Bass Brewers – Organisational Learning

11.9.1 Background

Bass Brewers is a large beer brewing organisation with a number of manufacturing sites in the UK. The application described here is a new approach to the way annual employee surveys are carried out, designed to encourage dialogue and learning, and provide a clearer steer to management regarding actions to take regarding specific ‘topics of concern’ identified by management. To encourage this dialogue, the organisation decided to trial the use of the Teamworker GSS with employee groups in three of its manufacturing plants; Cardiff, Glasgow and Birmingham.

11.9.2 Process Model

A set of 51 multiple-choice questions was designed in order to cover ‘topics of concern’ to management. Each of the questions was developed as a statement to which each participant could select one of five responses ranging from ‘strongly agree’ to ‘strongly disagree’. The topic definitions and numbers of questions in each topic are shown in Table 4.

| <i>Topic of Concern</i> | <i>No of questions within ‘topic of concern’</i> |
|--|--|
| 1. Organisation and Quality | 7 |
| 2. Motivation Reward and Recognition | 7 |
| 3. Leadership and Performance Management | 10 |
| 4. The Future | 8 |
| 5. Communications | 6 |
| 6. Involvement and Teamwork | 5 |
| 7. Training and Development | 8 |

Table 4: Topic Definitions for Areas of Concern

As an example, the six questions for Topic 5, Communications, are:

1. We are kept fully informed about what is going on at this site.
2. As a team we regularly get together to discuss work issues.
3. We are kept fully informed about the demands placed on the company and the strategy to achieve those plans.
4. I find team briefing a very useful form of communication.
5. I have the opportunity to air my views, which are responded to.
6. I believe communication between shifts is good.

Three different organisation sites were involved. A number of group interactive sessions were organised, each lasting about one and a half hours. The timing of sessions was designed to include shift-workers, and the group sizes varied from 8 to 16 people. The numbers of staff that took part in the group interactive sessions at each site are shown in Table 5.

| | Cardiff | Glasgow | Birmingham | Total |
|-----------------|---------|---------|------------|-------|
| Number Surveyed | 86 | 216 | 137 | 439 |

Table 5: Number of Staff Surveyed in Bass Brewers Application

Each group session included a mix of participants from more than one department, depending on when they were available. The software recorded which department each participant came from for subsequent (off-line) analysis of departmental differences of views.

Each group session was designed to run as follows:

1. The participants were provided with the handsets with which they responded with their handsets to each of the 51 questions appearing on screen, without any feedback. This typically took about 10 minutes.
2. The participants were progressively shown the results of their inputs in terms of each topic, which represented an aggregate of opinions over the given sub-set of questions.

3. Discussion of differences of opinion at topic level was encouraged in order to focus on the reasons behind the range of opinion displayed.
4. The participants were then shown the results of their inputs for each question relating to a given topic.
5. Discussion of differences of opinion at question level was encouraged again focusing on the underlying reasons behind the range of opinion displayed.
6. Finally, four questions relating to opinions of the session itself were asked and results displayed, without further discussion.

It is important to note that dialogue was encouraged at each of the stages 3 and 5 in an impersonal way. The group facilitator (a member of the organisation's HRM department) stimulated open discussion by enquiring into reasons why some people could be agreeing or disagreeing with the statement rather than asking particular people to respond to their own input in what could be perceived as a (personally) threatening process. This led to discussions that avoided personal identification with inputs, although sometimes participants chose to declare their own position.

Feedback screens used in this application are shown in Appendix C.

11.9.3 Experience

The question-by-question feedback screens frequently displayed considerable differences of opinion. The facilitator of the sessions felt that the anonymity of the process was responsible for what appeared to be the expression of a high level of personal honesty. It was quite easy for the facilitator to generate dialogue focussed on the reasons for the differences of opinion by referring to the displayed feedback screens. The emphasis was on gaining an understanding of the reasons behind collective views rather than on those of individuals. The on-line technology with group feedback, and the use of an un-attributed and impersonal style of facilitation made this easier. There was often a marked difference in perception for several of the questions. The reasons

for these differences emerged in a dialogue that the facilitator found easy to generate through using the system.

At the end of each session, four evaluation questions were asked of each participant, and the results of these are shown in Table 6.

| Evaluation Question | Strongly Agree | Agree | Unsure | Disagree | Strongly Disagree |
|--|-----------------------|--------------|---------------|-----------------|--------------------------|
| 1. I believe this has been an effective and quick way to conduct an employee attitude survey | 22 | 69 | 5 | 3 | 1 |
| 2. I believe the system is easy to use | 54 | 44 | 0 | 1 | 0 |
| 3. I believe the discussion sessions have allowed me to contribute more fully to the survey | 18 | 73 | 5 | 3 | 0 |
| 4. I believe the session has met its objectives | 16 | 66 | 15 | 2 | 1 |

Table 6: Percentage Results of Evaluation Questions Across All Three Sites (n=439)

There was overwhelming support for the use of the Teamworker GSS as a way of focussing and encouraging dialogue in the employee groups, and for encouraging greater participation in the group sessions. The technology and protocol for running the sessions appears to have the capability to provide participants with an intense episode in which the everyday constraints, which are imposed by emotional and political aspects of their positions, are temporarily suspended, and called into view for discussion.

The organisation decided to utilise the process for repeated use at each of the sites, rather than as a snapshot as originally planned. At the time of writing the process has been in use on a quarterly basis for three years at each of the three sites. This has meant that a number of facilitators have become involved with running the sessions. It has been possible to track changes to the responses to some of the questions, treated as variables, as the same question set has been used during this time. Some of these changes to variables have been interpreted by management as outcomes of actions taken as a result of insights gained from the group sessions. There has been an improvement of staff morale (as measured over time using the question set) which may be an outcome of providing the opportunity to hold regular and participative group sessions.

Based on the experience gained, it has recently been decided to revise the question set in the light of changing organisational conditions, but continue with the same process design. The availability of aggregated data from the handsets has also made it possible for the organisation to benchmark itself on some key variables against competitors.

11.9.4 Current Situation

Bass Brewers (now known as Coors) continues to use the Teamworker GSS regularly to help identify and discuss issues of concern with employee groups.

Further details of this application are reported in Gear *et al* (2003).

12 A Group Feedback Framework

The development and applications of Teamworker, as reported in this project, has led to the identification of a generalised group feedback framework, shown in Figure 11. This framework shows that the inputs from the group are transmitted to personal computer that can process these inputs. The inputs are fed back to the group in some summarised and meaningful way, using the large screen display in real time. The contention is that:

1. This feedback will enable differences to be understood in a non-threatening manner
2. This will encourage discussion and dialogue within the group as group members attempt to understand each other's points of view.
3. This will lead to group 'process gains' and reduce group 'process losses', thus producing a more effective group process.

Huber (1982: 212) describes process gains as, for example, "*the gain in decision quality resulting from one member thinking of a new and useful idea as a result of listening to the discussion of other members*". Process losses include, for example, "the loss in decision quality resulting from some members not having the opportunity to contribute their knowledge."

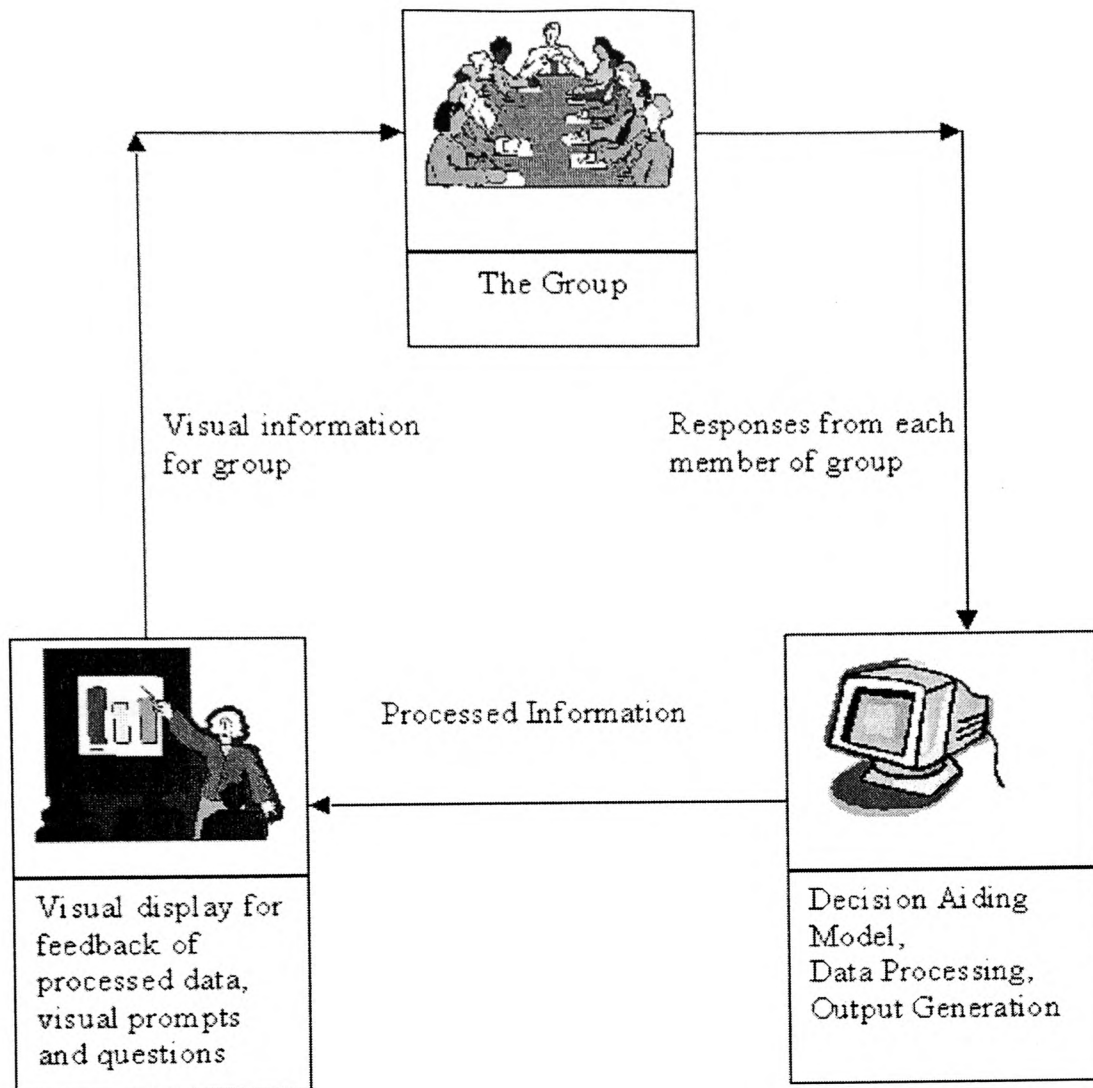


Figure 11: The Teamworker Group Feedback Framework

A number of judgemental processes can be built into this framework, including:

- Voting/Polling. E.g. selecting an item or option from a set; multiple choice answers
- Scoring options. E.g. evaluating each of a set of items or options on a pre-defined scale; scoring as a means of producing lists in rank order; scoring as a means of filtering long lists into short-lists.
- Comparing options. E.g. weighting the relative importance of a set of criteria by means of pairwise comparisons; evaluating subjective factors and parameters; assessing subjective probabilities and probability distributions; assessing attitudes to risk.

- Direct assessment. E.g. the estimation of parameters, probabilities and other factors by direct and subjectively based inputs

These judgemental processes can also be included in a decision analytic model (e.g. a multi criteria decision making framework). However, users will need to think carefully about the selection of a suitable decision analytic model to use, especially as many such models have been originally designed for individual and not group use.

13 A Group Support System Design Framework

The different field applications using Teamworker discussed in this project have involved a variety of task types, contextual situations and process models. The process model used to support a group task will involve a number of different elements including a social process framework (i.e. the approach the group will take to complete the task), a decision aiding framework (e.g. a mathematical decision-aiding framework such as Multiple Attribute Utility Theory, and which can help structure the task) and a protocol of social process involving the GSS (i.e. how the process framework and decision-aiding framework will be implemented for the particular group using a GSS). This process model will inevitably vary to reflect the task type and contextual situation. Finally, software and possibly hardware may need to be developed to reflect these variables.

Given that task type and the contextual situation can be understood (which requires a great deal of discussion with the groups who may wish to use a Group Support System) there are still a large number of possible operational system designs of a GSS that may be able to support the group complete the group task. A GSS Design Framework that identifies the complexity of the design issues and which has emerged from the applications of the GSS. This Group Support System Design Framework is shown in Figure 12, and shows a series of interlinking factors, demonstrating that there are dependencies between many of the different factors that must be considered when designing a GSS application for a specific task and context. This framework is discussed in more detail below.

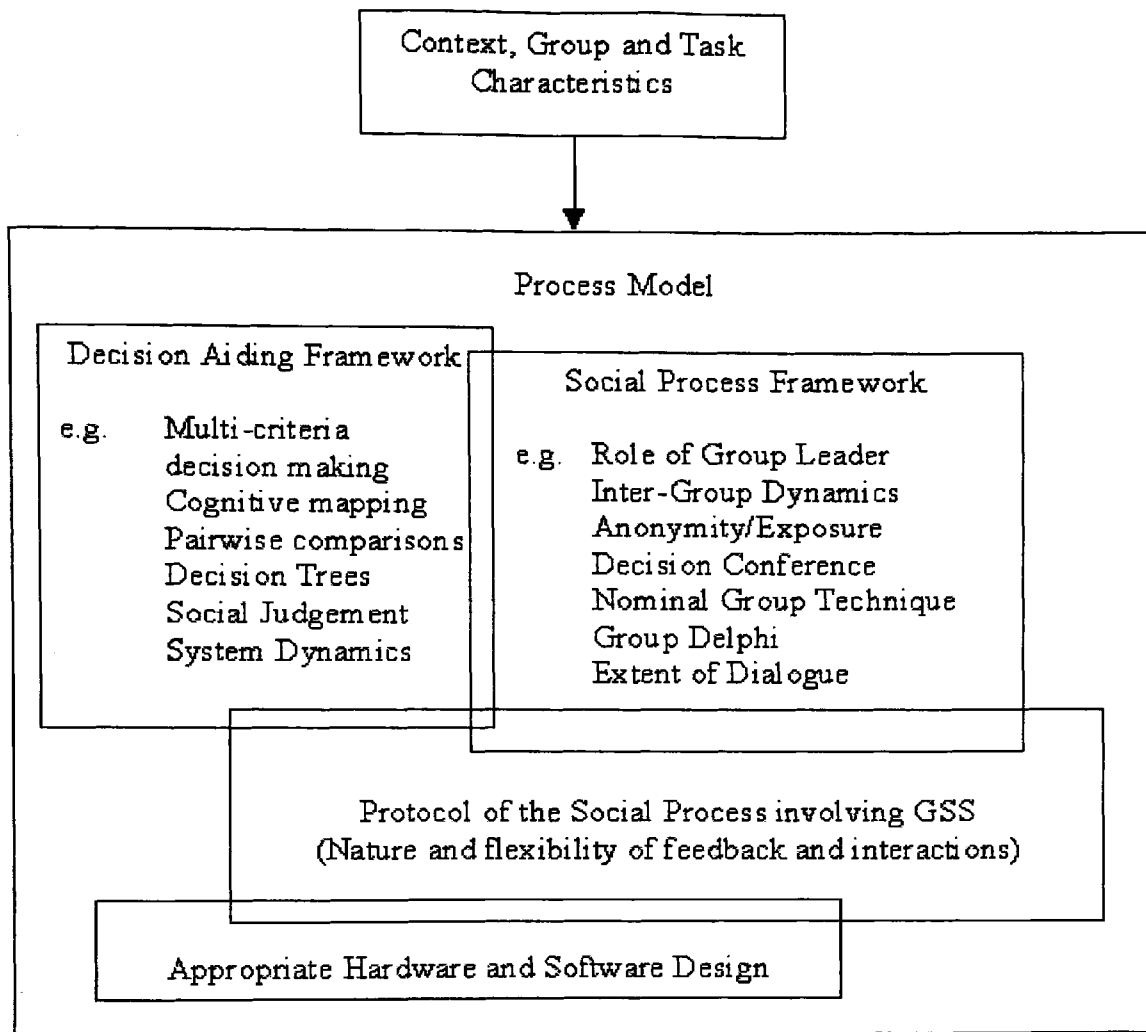


Figure 12: Group Support System Design Framework

13.1 Context, Group and Task Characteristics

Before a GSS can be designed, the context and group task needs to be understood as thoroughly as possible. The task may involve ranking a list of options, identifying the best solution to a problem, generating ideas, planning action, or simply trying to better understand a problem situation. It may be that in some situations McGrath's Task Circumflex (McGrath and Hollingshead, 1993:91) may be helpful to categorise the task.

Additionally, the situational factors need to be understood, including the group characteristics and organisational context. However, it will not always be possible to accurately identify and measure many of the elements included in many other research frameworks. For example, the framework developed by Pinsonneault and Kraemer (1990: 199) includes personal factors, such as attitude, abilities and individual motives.

In an organisational setting, where an organisational problem is being considered, many of these factors will remain unknown. What is important is that enough information about the task and the situation is understood to enable sensible decisions to be made regarding the design of the GSS.

13.2 Decision Aiding Framework

A number of decision-aiding frameworks may be considered, but whichever is adopted must fit with the context, group and task characteristics, as well as with issues of task de-composition. Groups will often require a great deal of transparency in how inputs are summarised and aggregated to ensure that the group members fully understand how any data is being manipulated.

13.3 Social Process Framework

A number of design decisions can be made regarding the social process framework. Issues such as anonymity, role of the group leader, use of Group Delphi and other group techniques, as well as the ordering of the meeting, will need to be compatible with the decision aiding framework and the nature of the task and situation.

13.4 Protocol of Social Process involving the GSS

How the GSS is going to be used with the group needs to be carefully designed and agreed with the group. For example, each of a set of questions can be asked, and then feedback given to the group once all questions have been asked (as occurred in the Bass Brewers application, Section 11.9). Alternatively, feedback can be given immediately following inputs for a specific question (as occurred in the Ministry of Defence application, Section 11.2). A further variation is that participants can give their responses in their own time, without having to wait for all other participants to enter their inputs before moving on to the next question (as occurred with the Carlsberg-Tetley application, Section 11.5). A possible social process protocol for a multiple criteria decision making application is given in Figure 13, however even here a decision will need to be made regarding the ordering of the questions (e.g. should weighting be undertaken before scoring of options?).

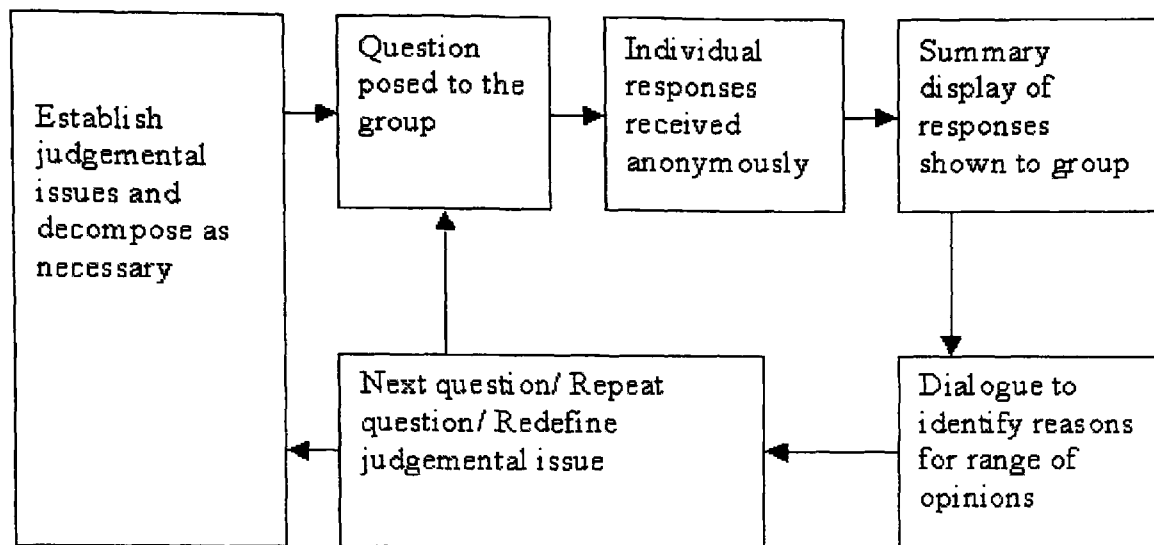


Figure 13: Possible Social Process Protocol for Multiple Criteria Decision-Making Application

The social process protocol adopted will be dependent on the situation of the group and, the task that the group is being asked to undertake, and the decision aiding and process frameworks that are to be adopted.

13.5 Appropriate Hardware and Software Design

Having gained some understanding of each of the elements above, then appropriate hardware and software can be designed and developed. Software (and where appropriate, hardware) should be designed using a prototyping methodology (e.g. Bocij *et al*, 1999:269), to enable representatives of the group that will be using the software to be fully involved in the design. It is also possible that pilot testing (e.g. Bocij *et al*, 1999:472) will also be required to ensure that the software performs as expected, and that the design features required by the group have been implemented. The development of the GSS and associated social process protocol should be a joint activity between the developers and the group who will be using the GSS (or at least representatives of the group).

13.6 Implications of the GSS Design Framework

The GSS Design Framework demonstrates that the different factors that need to be considered when designing a group support system, and identified in Figure 12 are not independent of each other. When designing a new GSS application, the problem becomes one of appropriate selection of a decision aiding framework, to operate in conjunction with a selected process framework, in order to implement a suitable protocol for the social process involving the GSS, for a given context and task.

Gallupe and McKeen (1990:11) have suggested that *“the use of GSS technology should be fine-tuned to the task and setting for which it will be used.”* Dennis *et al* (1989:308) argue that GSS researchers need to make explicit design decisions for aspects such as organisational context, group characteristics, tasks and GSS environments.

The technology of group support should seek to aid and enhance group processes and not inhibit or dominate them, and this will require careful attention to design aspects concerned with the process model. This might often require more than selecting from a pre-defined list of menu options that might be available with typical Group Support Systems, or accepting a particular decision analytic framework, as might be the case with particular type of facilitator led single personal computer GSS. Rather, the GSS will need to be carefully designed, in collaboration with the group who are to use the system, to meet the task and process needs of the group.

14 Group Support System Design Guidelines

Through my own experiences of developing Teamworker and applying the system in different situations, I agree with the findings of Watson *et al* (1994: 118), who, in a survey of k-GSS facilitators, identified that *“fast feedback of voting, the voting methods, the various visual displays, anonymous voting, and sub-grouping are all considered to be important features.”* The GSS applications reported in this project have enabled the identification of a number of design guidelines that can help focus the design of the Teamworker GSS in varied settings. These are:

1. Each participant should be fully involved in those stages of the process that are not pre-ordained by the context. In particular, setting objectives, generating alternatives, establishing and defining criteria with which to judge alternatives. These should be openly discussed, changed and filtered as the meeting progresses in a dynamic way.
2. As a means of identifying useful points of debate, and aiding meaningful discussions, all participants should have opportunities to input their judgements in terms of evaluations of the alternatives against each of the criteria, one with another, at a series of defined stages. At each stage, the complete set of inputs should be received prior to display to minimise social biasing effects.
3. Feedback of evaluations at each stage should be simple and graphic, displaying the set of values received from the group in a transparent way, with as little processing as possible, enabling a discussion of points of agreement and of disagreement (especially of polarised views).
4. At any stage, a display of differences of opinion followed by dialogue may indicate the need to revisit that stage or any earlier stage of the process, and this should be taken when necessary.
5. At some stages, it may be useful to aggregate results from each of the participants in some mathematical process of, for example, adding or averaging. On each occasion, this process should be made very clear to the group as well as any inherent shortcomings it may contain.
6. As a result of the inputs, feedbacks, discussions and analyses, the group should reach a collective choice, which is an agreed and preferred result, achieved by means of dialogue.
7. The technology of decision support should seek to aid and enhance group processes and not inhibit or dominate them, which requires careful attention to design aspects concerned with both hardware and software. This may require especially developed feedback screens.

8. Procedures and evaluation methods should be constructed to build on from cultural settings and prior experience of the group as part of a joint learning and development experience. These aspects may need attention in advance.
9. Questions requiring input of judgement from participants should normally be formulated in clear and unambiguous terms.

15 Discussion of Project One

The development of the Teamworker Group Support System stems from two separate experiences. The first of these was organising and feeding back the results of Military Judgement Panels (MJPs). It was felt that if MJP members could respond to questions anonymously and obtain summarised feedback of the individual opinions in real time, this would encourage focussed discussion on the important issues leading to greater insight, and would reduce domination by higher status members of the group. This point of view is also supported by the academic literature into Group Support Systems, where it is argued that an additional (anonymous) channel of communication should reduce group process losses, such as the effects of domination by individual members of the group, and improve group process gains, such as improvement in the understanding of issues (for example Huber, 1982; DeSanctis and Gallupe, 1987; Nunamaker *et al*, 1991). The second experience was a first development of a hard-wired system of handsets to enable a decision-making group to review feedback of its feelings in relation to progress on the task (Gear *et al*, 1985).

Most Group Support System developments have involved networked personal computer approaches (known as w-GSS by Watson *et al*, 1994), such as GroupSystems and SAMM, and the majority of academic research into GSS is concerned with these types of systems (Pervan, 1998). Such systems require a large investment in equipment, and also require the use of a dedicated 'decision room' that contains the system. The Teamworker GSS was designed to be a more portable system that could be used in any meeting room, and easily taken from room to room, using only a single personal computer (or laptop computer), a large screen (using an overhead projector) and a

number of portable handsets that could send messages to the computer using radio telemetry. This is termed 'low-impact' technology, as the technology supports the meeting environment but does not dominate it. The system is highly portable, and can be set up and operational within 10 minutes.

An early type of hard-wired k-GSS is described in Gear *et al* (1985). Other similar group support systems have been developed around the same time as Teamworker, the most well-known and used of these being OptionFinder, developed in Utah, USA (e.g. Flexner 1995). This system was originally developed using hard-wired technology, a technology that we believed was intrusive for managerial groups (OptionFinder has since implemented radio telemetry handsets, using advice provided on the basis of experiences with Teamworker). A further difference is that OptionFinder typically relies on standard feedback screens (for example X-Y grids) whereas Teamworker applications have often required unique and purpose developed feedback screens (Appendix C identifies some of the group feedback screens developed for different Teamworker applications).

There has been limited academic research published concerned with handset based group support systems – the Literature Review identifies some of the published research articles on these types of system. It is interesting that Watson *et al* (1994: 123) describe k-GSS as 'less glamorous' than w-GSS, and this may be a reason for the substantially less research available on this type of system. This portfolio of work is a substantial contribution to the knowledge base on this type of system, albeit specifically concerned with the Teamworker system. The applications described in this project also support other published work that is available for group support system applications in the field.

For example, field studies have consistently shown high satisfaction ratings with groups that use a group support system (e.g. Nunamaker *et al*, 1993; Chun and Park, 1998). The comments received from participants using Teamworker in the applications reported in this project are also consistently positive. Participant evaluations are also positive, for example the Northampton County Council application (Section 11.7). Many informal communications between myself and participants confirm this view – the vast majority of informal comments on the use of the system have been positive from a user satisfaction point of view. As Eden (1995: 308) argues, unsolicited

comment may be a more reliable method of obtaining evaluation information from management groups making use of a GSS than more formal approaches, such as a questionnaire approach. However, it should also be noted that users can be happy with a methodology that may be flawed (e.g. Belton and Gear, 1982).

Research on group support systems suggest that a GSS can support a less confrontational and threatening environment, often because of the ability of participants to give their opinions anonymously and without undue influence from other members of the group (e.g. Nunamaker *et al*, 1993, Watson *et al*, 1994). This is also supported by the comments of participants in the applications reported in this project, e.g. SmithKline Beecham (Section 11.1), Ministry of Defence (Section 11.2), Bass Brewers (Section 11.9) and Pharmaceutical Education (Section 11.4).

GSS research suggests that process structuring helps to keep the participants focused on making the decision, reducing tendencies toward digression and unproductive behaviour (e.g. Nunamaker *et al*, 1993; Watson *et al*, 1994). Support for these observations can be found in the comments of participants of the following applications reported in this project: SmithKline Beecham (Section 11.1), Ministry of Defence (Section 11.2) and Carlsberg-Tetley (Section 11.5).

Nunamaker *et al* (1997) and Watson *et al* (1994) have identified a number of other issues, specifically concerning handset based group support systems (and reported in the Literature Review) that find support in the applications reported in this project:

1. GSS polling can be used to clarify communication, focus discussion, reveal patterns of consensus or stimulate thinking (e.g. SmithKline Beecham, Section 11.1; Ministry of Defence, Section 11.2; Carlsberg-Tetley, Section 11.5).
2. GSS polling can demonstrate areas of agreement, allowing groups to close off discussion in those areas and focus only on areas of disagreement (e.g. SmithKline Beecham, Section 11.1).
3. GSS polling can fuse the aggregate judgement or opinions of all group members into a true group position. (e.g. Oil corporation, Section 11.3; EPSRC, Section 11.8; Bayer plc, Section 11.6).

4. Meetings can have more participants without loss of effectiveness (e.g. Oil corporation, Section 11.3).
5. GSS polling can be used to formally register dissenting opinions (e.g. SmithKline Beecham, Section 11.1)
6. GSS polling can shorten the meeting time (e.g. SmithKline Beecham, Section 11.1)

Much of the feedback and many of the comments received from participants in the applications and sponsors of the applications reported in this project have been very positive. However, many of the organisations discussed in the case studies have discontinued use of the system. A number of reasons for this may be identified.

1. Requirement for an internal 'Champion'. Bidgoli (1996: 62) identifies the need for an internal 'champion' to illustrate how the organisation can benefit from the use of a Group Support System. If such a champion leaves his or her post without somebody else taking on this role, then it is unlikely that there will be continued use of the system.
2. Organisational changes may make the use of the system obsolete.
3. Lack of Top Management Support. Bidgoli (1996: 62) also sees this as a crucial requirement for continued use of a Group Support System. The use of a GSS can affect the power structures within groups, which may be to the detriment of certain powerful individuals.
4. Technological Issues. The GSS must operate perfectly to be accepted by the group. If the GSS is not totally reliable in a particular situation, or the environment is not conducive to its use, then its use is likely to be discontinued.
5. Despite positive feedback, users may feel that the benefits of using a GSS do not outweigh the costs. Benefits may include an improvement in the effectiveness of the group process, but costs will include a reliance on technology, the requirement to possibly alter the task structure and the group process to fit with the GSS, and also the budgetary cost of buying/hiring the technology and other

support including the possible use of a facilitator. Bidgoli (1996: 62) identifies the requirement for the technology to match users' needs, as well as there being a perceived need for a GSS, as crucial for the success of a GSS

The development of Teamworker and the associated field applications has led to the development of a Group Feedback framework, a GSS Design Framework and GSS Design Guidelines that help in our understanding of how a GSS such as Teamworker can be designed and used with a group.

From the field applications discussed in this project, the Teamworker GSS does appear to have value in certain situations, particularly where individual learning and the encouragement of dialogue and discussion is important within a particular context. In decision making situations involving senior managers, where the context will necessarily be different from application to application, and where individual power may be an important concern, the value of the system is difficult to ascertain.

Evaluation of a GSS is a complex task, and can involve a variety of approaches, as identified in the Literature Review. Projects Two and Three of this portfolio enable a more in-depth evaluation to be undertaken, as each of the applications reported in these projects involved a number of different groups meeting over a number of years, and the data collected during the group meetings supported by Teamworker enable evaluation in terms of the design objectives of the GSS in each application.

CHAPTER THREE

PROJECT TWO

USE OF A GROUP SUPPORT SYSTEM IN RESEARCH COMMITTEES

16 Introduction

This project is based upon the development and implementation of the Teamworker GSS with research committees from a public-sector Research Award Body over a five-year period. The peer group committees were used to rank research proposals from universities and other establishments to enable funding decisions to be made. The data was collected using Teamworker, and four years of this data has been analysed to consider the sensitivity of the rankings produced (and therefore the funding decisions made) on a number of factors. In this way, the data collected from Award Body peer group research committees over a four-year period has enabled an evaluation of the decision model used to produce the ranked lists of research proposals.

16.1 Objectives of Project Two

The objectives of this project are:

1. Using an Action Research approach, discuss the development and implementation of the Teamworker GSS with a public-sector Research Award Body.
2. Evaluate the satisfaction of the Award Body on the usefulness of the system (people centred evaluation).
3. Evaluate the process used to produce the research proposal rankings through using the Teamworker GSS (process centred evaluation).
4. Discuss the significance of this evaluation in terms of GSS design effectiveness.

17 Using Teamworker for Ranking Research Proposals

Following the successful use of Teamworker to help support the research priorities of the Award Body, which involved a criteria weighting and option scoring exercise, both the Award Body Officers and members of each of the Research Committees realised that Teamworker could also be useful for ranking research proposals in each of the different Research Committees that formed part of the Award Body. This ranking of research proposals was a large task; the ranking of research proposals by the Research

Committees was a task that took between one and two days, and the Teamworker GSS would be required to support the process throughout this period of time.

A working group was established that comprised myself, Prof Gear, the Head of the Science Division of the Award Body, other senior Award Body Officers and representatives of the Research Committees. This working group was responsible for designing the Teamworker software that would be used for the ranking task, and for developing the procedures and processes that would be used in the ranking process supported by the Teamworker GSS. In practice, I completed the software design and development work, with frequent demonstrations to the rest of the group as the software was being developed. A prototyping approach was therefore used in the design and development of this software (see Bocij *et al*, 1999:269).

Two criteria were adopted for the ranking of research proposals, these being Scientific Excellence and Relevance to Policy. The final ranking itself would only be determined by the Scientific Excellence criterion; the Award Body had used this criterion for many years. Each proposal would be scored on each of these two criteria using a 1 to 5 scale, where 5 was the best score that a proposal could obtain and 1 was the worst. Again, this scoring scale had been well used by Award Body for some time, and Award Body officers felt that no further explanation was required to explain the scale. In general, only those proposals that obtained an average score of over 3.5 could be certain of obtaining funding from Award Body, and those proposals that obtained an average score of below 3 would be very unlikely to obtain funding.

The completed Teamworker GSS design (hardware, software and procedures) took approximately two months to complete – it was then implemented with each of the three Research Committees. The main design objectives of the Teamworker GSS in this application was to enable the Research Committees to give funding advice to the Award Body Central Office in a relatively short period of time, and to help reduce domination by a few committee members.

17.1 Research Committee Process

Invited peer group committees of 7 to 19 members met in each of a number of scientific areas administered by Funding Body officers. The committees were tasked with assessing research proposals submitted by researchers based in universities and higher education colleges. Committee membership in each scientific area was relatively stable, with the majority of members serving for three years at a time. Each committee met twice yearly for 1 or 2 days in order to assess, and recommend selection or rejection, of up to 200 proposals. The overall budget was well defined, but the precise apportionment between the scientific areas covered by each of the committees was left somewhat flexible, depending on the quality of marginal submissions, when the committees met.

The layout of the Research Committee 'decision room' is shown in Figure 14. The Award Body Secretary had a controlling handset with which to remotely control the Teamworker software.

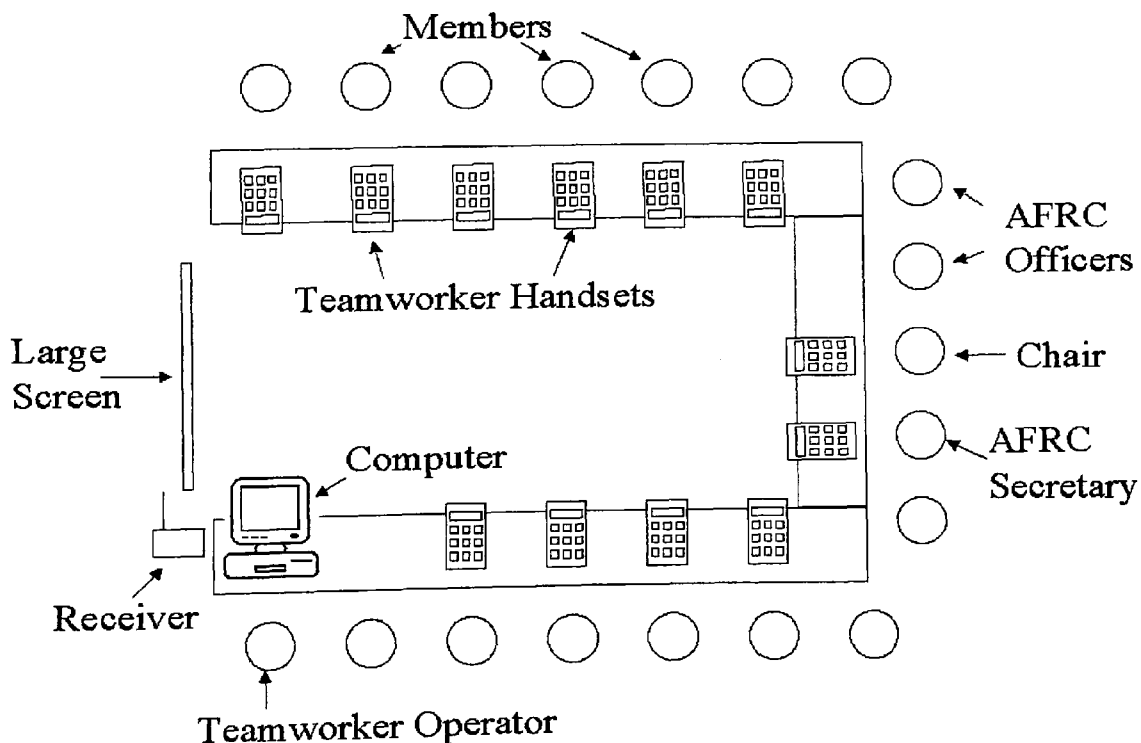


Figure 14: Research Committee Decision Room Layout

At each committee meeting, the complete list of proposals was held in the GSS software so that specific proposals could be called up for display in either agenda (usually alphabetical) or some other order. The display showed only the proposer's name, institution, and project cost, although committee members also had available a detailed hard copy of each proposal in advance of the meeting (see Figure 15 - note that this example uses an anonymised grant proposal.).

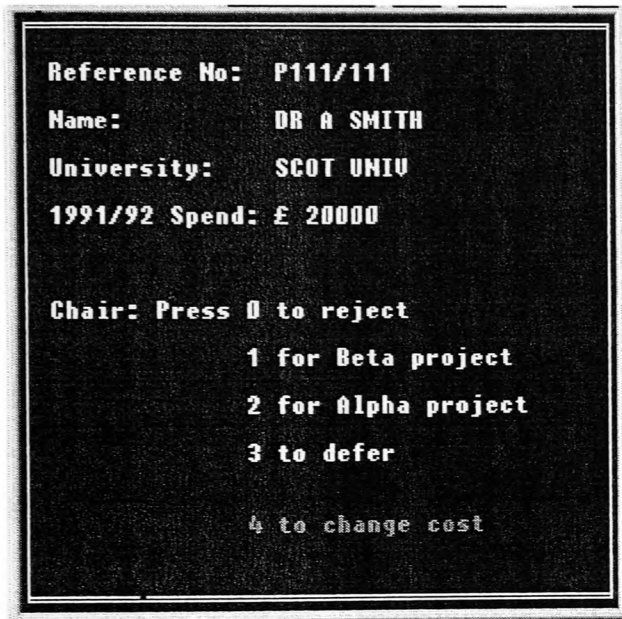


Figure 15: Research Proposal Details Screen (Research Proposal Ranking)

One or more nominated committee members (expert in the given topic of the research proposal) presented each proposal, referees' comments were noted, and a short discussion of views and points of clarification was held. At this point, the chairperson summarised the position and stated whether this project was of a fundable type (as opposed to a non-fundable type of project). When a fundable project was identified, each committee member anonymously scored the given proposal, using a Teamworker GSS handset, on the two criteria: 'scientific excellence' and 'relevance to policy'. A 5-point scoring scale was used for each criterion, with 1 (low) and 5 (high). As already identified, this scale was very familiar to a majority of the membership, having been in use over several years. The extremes of this scale were defined in a 'global' rather than a 'local' sense.

The mean scores and standard errors of the means for each of the two criteria were displayed after each set of inputs, and these were infrequently discussed further at this stage (see Figure 16).

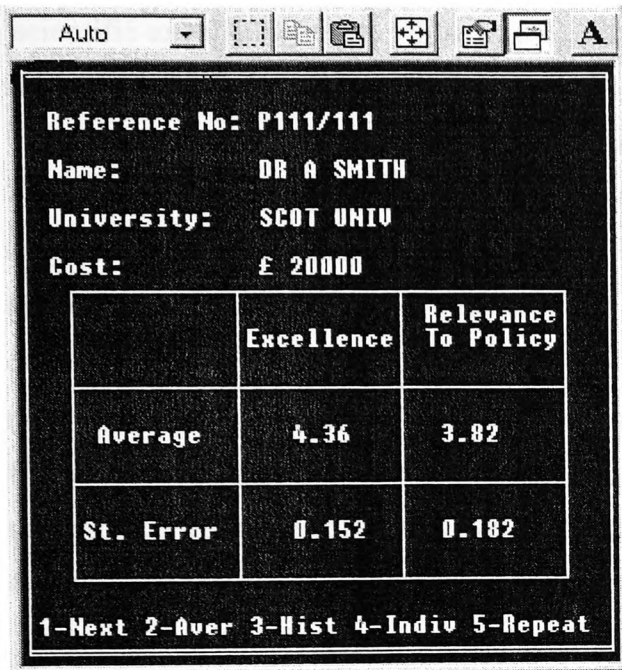


Figure 16: Research Proposal Feedback Screen (Research Proposal Ranking)

Bar charts showing the distributions of scores could be displayed optionally, but this was not a frequent occurrence (see Figure 17).

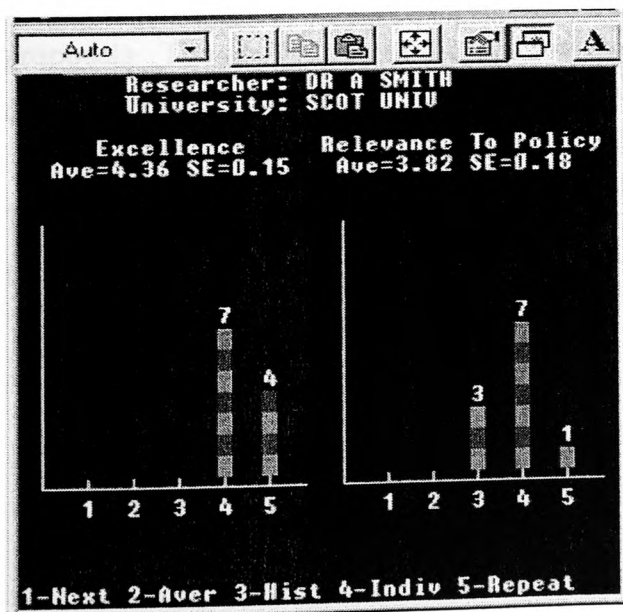


Figure 17: Feedback Bar Charts of Inputs (Research Proposal Ranking)

After all proposals had been treated in this way, an overall rank ordered list of fundable projects was printed and given committee members, based on mean scores for 'scientific excellence' only, while also displaying the 'relevance to policy' mean and standard error alongside.

The running total of aggregate first year costs was available to Award Body Officers only (not the committee members). The definition of an approximate range from minimum to maximum budget allocation for the given committee allowed identification of a number of 'grey' projects falling within this range. The grey projects were then reviewed by the committee to identify those projects that they might want to support if sufficient research funds were available. In general, it was assumed by the committee that projects above the grey area were selected and those below rejected although exceptionally, some proposals were discussed further and then re-scored.

18 Evaluation of the Teamworker GSS with Research Committees

The task of ranking research proposals was supported by the Teamworker GSS in over 40 separate Research Committee meetings. Each meeting comprised of between 7 and 20 members, and each meeting was required to rank between 5 and 200 research proposals. The application of the Teamworker GSS by the Award Body has been discussed in Gear and Read (1993) and Read *et al* (2001a).

The evaluation of the Teamworker GSS with the Research Committees is considered from two different perspectives.

- a) Evaluation of the perceived usefulness of the Teamworker GSS in meeting the objectives of the Award Body (people centred evaluation approach).
- b) Evaluation of the process used to produce the research proposal rankings through use of the GSS (process centred evaluation approach).

18.1 Evaluation of the satisfaction of the perceived usefulness of the Teamworker GSS in meeting the objectives of the Award Body

The satisfaction of the Award Body of the usefulness of the GSS will generally be an outcome measure in terms of the Input-Process-Outcome evaluation research framework identified in the Methodology chapter. Satisfaction of the GSS is considered using the people centred evaluation approach discussed in the Literature Review and highlighted in the evaluation research framework.

The Head of the Science Division has made a number of comments of the usefulness of the Teamworker system with the Research Committees. Example comments from the Head of the Science Division are:

I've found it very valuable, and it really concentrated minds

I liked the way it forced you to think and be consistent, whereas normally you just waffle

(the Award Body) gets more information than before, with significantly more precision,

From these comments, it appears that the system was useful for Award Body, as least from the point of view of the Head of the Science Division. However, it is not as clear that all members of each of the Research Committee meetings were as enthusiastic. In introducing the system, the Head of the Science Division reports that he met with varying responses,

from real enthusiasm to outright aggression,

The Head of the Science Division also reports that, when introducing the system,

The committee members were pretty upset

However, after one more session, a hostile chair had embraced the system and was referring to the system as "*the usual method*".

These comments identify the difficulties of evaluating the user satisfaction of a GSS system. It was not possible to distribute questionnaires to Research Committee members, and we were discouraged from formally interviewing Research Committee members about their perception of the usefulness of the system. However, I did receive informal feedback through the Award Body officers, and also directly from the Research Committee members.

In general, the Award Body Officers were very supportive of the system, as they felt that it:

- Made their life easier, in that all scoring inputs were automatically captured.
- Helped committee members become more consistent in their scoring.
- Reduced domination by a few committee members. In discussions with Award Body Officers, this had been noted as a problem in previous research proposal ranking exercises.
- Enabled the agenda to be completed in the time available. For some Research Committees the agenda was extremely large, with over 200 proposals to be properly considered. The Award Body Officers felt that the introduction of the GSS had enabled the research proposal ranking exercise to be better structured, and that the use of the handsets enabled the chairperson and Award Body Secretary to contain and curtail discussion when necessary.

The responses of individual members of the Research Committees were more varied. Many members were very supportive. Some members however, particularly some of the Chairs of the Research Committees, felt that the system took away some of the functions of the chair, especially the ability to issue 'binding' advice to the committee when contentious issues arose. It will be a rare group that completely agrees on the usefulness of using a GSS to support the task of the group – each member within the group is an individual, and brings to the group their own personalities and political agendas.

The Teamworker GSS continued to be used by the Research Committees for five years until the Award Body was replaced by another organisation, demonstrating long term acceptance by the Research Committees. Eden (1992:215) has argued, "*if the client group likes the GDSS, it clearly has some credibility.*" Martz *et al* (1992:154) has also considered continuing use of a GSS by an organisation under the term "Propensity to Use", and identifies this as an indication of the successful implementation of a GSS and acknowledgement of the system's value to the organisation. It may be argued that for a GSS system to be used continuously over a period of five years demonstrates that the client group finds the GSS useful and attributes value to the GSS.

18.2 Evaluation of the process used to produce the research proposal rankings

The evaluation of the process used to produce the research proposal rankings has concentrated on an examination of the effect of the decision-aiding framework used as part of the process through an analysis of the input data captured during the meetings. A process centred evaluation approach, as discussed in the Literature Review and highlighted in the evaluation research framework in the Methodology chapter.

The process used to obtain the research proposal rankings involved:

1. The determination of individual 'Scientific Excellence' and 'Relevance to Policy' scores by each committee member for each research proposal judged to be 'fundable'.
2. The use of the mean of the 'Scientific Excellence' scores to determine a ranked list.
3. The identification and discussion of a 'grey list' of proposals that contained those projects that the Research Committee might want to support if sufficient research funds were available.

The particular process adopted by the committees for individual scoring, and aggregation to produce overall rankings, is open to criticism. However, it does represent one relatively convenient approach to committee work that merits further analysis.

18.2.1 Issues of Aggregation of Scores

The ‘impossibility theorem’ of Arrow (1951) showed that there is no fair way to form a group ranking from a set of individual rankings. The issues involved in combining rankings supplied by individuals in a committee situation have been well reviewed by others: for a survey see Vincke (1982). More recently, Chebotraev and Shamis (1998) have surveyed over 40 methods for preference aggregation. These reviews serve to highlight the variety of approaches that have been proposed, each with its strengths and weaknesses.

Different models vary in their demands on data input from committee members. For example, one fundamental model for consensus formation has been developed by Kemeny and Snell (1962:9) and which requires only ordinal rankings of the options from each member. Cook and Kress (1985) have developed a more refined model where each member may be asked to provide information on his or her intensity of preference for one option over another. Not only do the more refined models make more demands on participants, but also solution algorithms and associated forms of sensitivity analysis can result in problems of understanding and communication in groups. Easley *et al* (2000) have compared various methods for capturing group preference rankings, including the Analytic Hierarchy Process. There are also procedures whereby, as well as scoring options, participants in a group can also weight the scores given by the participants in a group who may have more knowledge on a situation (e.g. Snizek and Henry, 1989; Balthazard, 1996).

The way in which the committees operated was on the basis of producing a complete rank ordering, based upon the ‘scientific excellence’ criterion. To do this, the committee members each effectively supplied a complete rank order of proposals (although with a five-point scale, ties are not only possible, but inevitable). Two similar decision making problems discussed in the literature may be found in Libertore *et al* (1992) and Ngwenyama *et al* (1996).

Libertore *et al* (1992) discuss a decision where a committee at a college of a university reviews research papers for a research awards programme. The group size is similar to that considered here, but the number of options (research papers in their case) is much smaller. Their task was to partition the papers into those recommended for an award, and the rest, but this was actually done on the basis of producing a complete rank ordering.

Ngwenyama *et al* (1996) discuss a decision involving a committee of 12 people assessing five candidates for the academic post of dean; their task was to choose the best candidate and one reserve. Initially, each committee member scored each candidate on a nine-point scale, then assessed the relative strength of their preferences. The committee's facilitator then took on the task of achieving consensus, supported by a mathematical analysis of the preferences.

18.2.2 Specific Process Issues

In this section the data from 28 separate committee meetings have been used to investigate the effect on the rank order of the following process issues.

- a) Position in agenda of a proposal
- b) Financial value of proposal
- c) The scoring system used for ranking the proposals
- d) The aggregation method used for ranking the proposals
- e) Disregarding one member's scores

18.2.3 Data Set

The sets of scores from a total of 28 individual committees, meeting over a period of four years, have been analysed in this paper. The size of the committees varied between 7 and 19 members, and the number of proposals that were prioritised by each committee varied between 4 and 105 proposals (a significant number of other proposals were not considered worthy or relevant for prioritisation).

Table 7 shows the number of different committee meetings analysed for each committee meeting period.

| Meeting Period | Period 1 | Period 2 | Period 3 | Period 4 | Period 5 | Period 6 | Period 7 |
|------------------------------|----------|----------|----------|----------|----------|----------|----------|
| Number of Committee Meetings | 3 | 4 | 6 | 4 | 3 | 4 | 4 |

Table 7: Number of committee meetings considered in each meeting period

18.3 Analysis of the Ranked Lists of Proposals

The analysis of the committee data is focussed on the “scientific excellence” scores only, as this was the criterion used by the committees to produce the ranking of proposals. All references to “scores” from here on refer to the “scientific excellence” scores. To preserve anonymity, the committees have been identified only by letter, the same letter (e.g. Committee A) indicating the committee responsible for a particular scientific area. To address the process issues identified in the previous section, a number of propositions, each based on a “null hypothesis” have been developed and analysed, as follows:

18.3.1 Effect of Position in Agenda on Rank Order

Arguments are sustainable for each of two opposing possibilities regarding this issue. On the one hand, it could be argued that proposals placed early in the list may be disadvantaged, because the committee members have not yet “found the range” of how good a proposal needs to be in order to be funded, and might therefore choose to be over-cautious in their assessments. Conversely, it could be argued that later proposals might be disadvantaged, as “ranking fatigue” sets in, and the amount of money perceived available is reducing.

To test the hypothesis that the position of a proposal in the agenda does not influence the final ranked position of the proposal, the correlation coefficient (r) for mean score and position in agenda has been calculated for each of the research committees. These are shown in the fifth column of Table 2. To test whether this r value is significantly different from zero, a test statistic is calculated from the equation:

$$t = r \sqrt{\frac{n-2}{1-r^2}}$$

where n is the number of rated proposals. This follows a t distribution with $n-2$ degrees of freedom (Bhattacharyya and Johnson, 1977:410). The calculated values of the test statistic are shown in the sixth column of Table 8. As may be seen, three meetings show a significant correlation. However, two of these three are negative correlations, and in any case one might expect at least one sample in 28 to show a difference at the 0.05 level by chance. There is thus slight evidence that in three meetings the position in the agenda may have made a difference to the excellence score, but there is no systematic effect overall. It can therefore be concluded that there does not appear to be a relationship between the mean rating of a proposal and its position in the agenda in these committee meetings.

| Meeting Period | Committee | Number of Rated Proposals | Number of Committee Members | Mean Excellence Score and Position in Agenda - (r) | t statistic | Mean Excellence Score and Value of Proposal - (r) | t statistic |
|----------------|-----------|---------------------------|-----------------------------|--|---------------|---|---------------|
| Period 1 | A | 56 | 8 | -0.02 | -0.147 | -0.06 | -0.442 |
| | B | 68 | 12 | 0.33 | 2.840** | 0.13 | 1.065 |
| | C | 22 | 12 | -0.12 | -0.541 | -0.01 | -0.045 |
| Period 2 | A | 46 | 14 | -0.05 | -0.332 | 0.23 | 1.568 |
| | B | 67 | 15 | 0.07 | 0.566 | 0.27 | 2.261** |
| | C | 29 | 12 | 0.07 | 0.365 | 0.08 | 0.417 |
| | E | 16 | 12 | -0.20 | -0.764 | -0.19 | -0.724 |
| Period 3 | A | 60 | 10 | -0.31 | -2.483** | -0.16 | -1.234 |
| | B | 59 | 15 | -0.15 | -1.145 | -0.09 | -0.682 |
| | C | 22 | 9 | 0.07 | 0.314 | 0.45 | 2.254** |
| | D | 5 | 11 | 0.47 | 0.922 | 0.15 | 0.263 |
| | F | 60 | 12 | -0.17 | -1.314 | 0.39 | 3.226** |
| | G | 40 | 13 | 0.01 | 0.062 | -0.08 | -0.495 |
| Period 4 | A | 62 | 14 | 0.08 | 0.622 | 0.37 | 3.085** |
| | B | 75 | 18 | -0.06 | -0.514 | -0.23 | -2.019** |
| | C | 13 | 12 | -0.05 | -0.166 | 0.42 | 1.535 |
| | D | 6 | 13 | -0.32 | -0.676 | -0.43 | -0.953 |
| Period 5 | A | 61 | 14 | -0.15 | -1.165 | 0.31 | 2.505** |
| | B | 102 | 16 | -0.09 | -0.904 | 0.11 | 1.107 |
| | D | 12 | 10 | 0.20 | 0.645 | -0.25 | -0.816 |
| Period 6 | A | 73 | 12 | 0.08 | 0.676 | 0.18 | 1.542 |
| | B | 96 | 19 | 0.04 | 0.388 | -0.03 | -0.291 |
| | C | 38 | 12 | 0.05 | 0.300 | 0.26 | 1.616 |
| | D | 4 | 12 | 0.40 | 0.617 | -0.54 | -0.907 |
| Period 7 | A | 83 | 14 | 0.18 | 1.647 | -0.07 | -0.632 |
| | B | 105 | 17 | -0.21 | -2.180** | 0.00 | 0.000 |
| | C | 21 | 7 | -0.10 | -0.438 | -0.23 | -1.030 |
| | D | 10 | 10 | -0.05 | -0.142 | 0.17 | 0.488 |

Table 8: Effects of position in agenda and financial value of proposal (** denotes rejection of null hypothesis at 0.05 level)

18.3.2 Effect of Financial Value of Proposal on Rank Order

As with the previous issue, contradictory arguments may be advanced. For example it may be that proposals requiring relatively greater funding are less likely to be supported because they consume relatively more of the funds available. On the other hand, it can be argued that smaller proposals are more likely to be under-resourced for the work planned, and perhaps may not be so well prepared. In addition, only well-established research groups are likely to have the infrastructure in place to support larger proposals.

To test the hypothesis that the financial value of the proposal does not influence the final ranked position of the proposal, the correlation coefficient for financial value and mean score was calculated for each of the research committees, as shown in the seventh column of Table 8. The statistical test is the same as that for the effect of the position in the agenda; calculated values of the test statistic are shown in the final column.

Here the null hypothesis is rejected at the 0.05 level in 6 of the 28 cases. In 5 of these, the higher value proposals tended to be rated more highly. It therefore appears that in a minority of these committee meetings there is a relationship between the mean rating of a proposal and its financial value.

18.3.3 Effect of the Scoring System Used on Rank Order

An issue of methodological significance is whether the use of the five-point scale actually affects the results of the decision-making process, as compared with the use of scales which are either coarser (i.e. having fewer points) or finer (having more points).

It is only possible to consider one of these two potential effects, this being what might have happened if a coarser scale had been used for rating. This was achieved in this analysis by combining some of the categories in the existing scale. The five-point scale is coarsened to a three-point scale, by removing categories 1 and 5; scale categories 1 and 2 on the original scale both map to category 2 on the coarser scale, and categories 4 and 5 both map to category 4 on the coarser scale, as shown in Figure 1. This is not a perfect simulation of what the decisions of the committee members would have been, since the scale itself could influence the scores given by the committee members.

However, it should give an indication of how sensitive the ranking of the proposals is to the scale used.

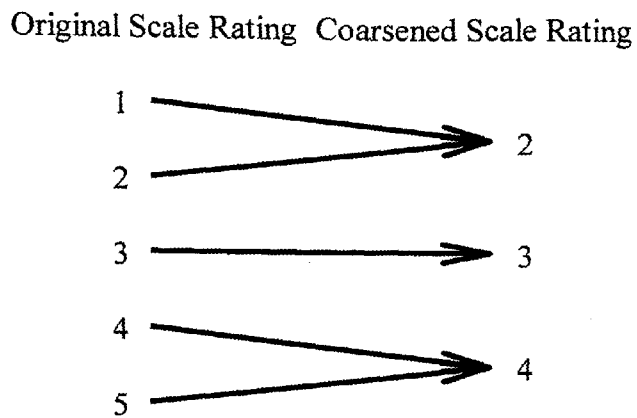


Figure 18: Method adopted for coarsening scale

The proposition put forward here is:

“The use of a coarser scoring scale has no effect on the ranking of a proposal based on its mean rating”.

The ranks obtained from using the original 5-point scale and the coarsened 3-point scale have been compared using the Spearman Rank-Order Correlation Coefficient r_s . These analyses are shown in Table 9.

| Meeting Period | Committee | Number of Rated Proposals | Number of Committee Members | Mean Rank v Coarsened Mean Rank – (r_s) | Mean Rank v Median Rank – (r_s) |
|----------------|-----------|---------------------------|-----------------------------|---|-------------------------------------|
| Period 1 | A | 56 | 8 | 0.989 | 0.965 |
| | B | 68 | 12 | 0.990 | 0.928 |
| | C | 22 | 12 | 0.979 | 0.929 |
| Period 2 | A | 46 | 14 | 0.991 | 0.956 |
| | B | 67 | 15 | 0.980 | 0.958 |
| | C | 29 | 12 | 0.969 | 0.977 |
| | E | 16 | 12 | 0.962 | 0.966 |
| Period 3 | A | 60 | 10 | 0.991 | 0.970 |
| | B | 59 | 15 | 0.991 | 0.962 |
| | C | 22 | 9 | 0.994 | 0.970 |
| | D | 5 | 11 | 1.000 | 0.950 |
| | F | 60 | 12 | 0.982 | 0.937 |
| | G | 40 | 13 | 0.987 | 0.938 |
| Period 4 | A | 62 | 14 | 0.990 | 0.966 |
| | B | 75 | 18 | 0.977 | 0.952 |
| | C | 13 | 12 | 0.996 | 0.826 |
| | D | 6 | 13 | 1.000 | 0.929 |
| Period 5 | A | 61 | 14 | 0.996 | 0.940 |
| | B | 102 | 16 | 0.978 | 0.952 |
| | D | 12 | 10 | 0.993 | 0.904 |
| Period 6 | A | 73 | 12 | 0.984 | 0.960 |
| | B | 96 | 19 | 0.982 | 0.957 |
| | C | 38 | 12 | 0.937 | 0.961 |
| | D | 4 | 12 | 0.950 | 0.950 |
| Period 7 | A | 83 | 14 | 0.977 | 0.956 |
| | B | 105 | 17 | 0.978 | 0.946 |
| | C | 21 | 7 | 0.984 | 0.956 |
| | D | 10 | 10 | 1.000 | 0.912 |

Table 9: Effects of scoring system used and one committee member's opinion

Table 9, fifth column shows the r_s values for the research committees. All are significant at the 0.01 level (one tailed); indeed, all but those from the meeting where only 4 proposals were rated are significant at the 0.001 level in statistical terms. These high rank correlations demonstrate that projects ranked highly on the original 5-point scale tend to remain so on the coarser scale. The same is true for low ranked projects. However, this does not preclude the possibility of significant changes in the ranked positions of individual proposals in the set when the scale is coarsened from 5 to 3 points.

In order to obtain an indication of the magnitude of this effect, a more detailed analysis of the changes to position of the proposals in the rankings produced from the 5 and 3-point scales, using the data from the four Period 2 committee meetings, has been

undertaken. The results of this analysis are summarised in Table 10. A study of this table shows that many proposals change their ranked positions by several positions, with greater changes tending to occur in the larger sets of proposals (greater N values).

For example, out of the 46 ranked proposals in Committee A there was a mean rank change of 1.3 positions and a maximum rank change of five positions, which may have led to some changes to the set of proposals selected for funding. Therefore precisely which projects are identified as being in the grey area, and the relative ranking of the projects, can be affected substantially by the coarsening of the scale. This could lead to consequent changes to the set of proposals selected for funding.

Following the analyses of the Period 2 meetings, the effects of changing the scoring scale has also been analysed for the other 27 committee meetings in the data set. A summary of these analyses is shown in Table 11

| Committee Meeting (Period 2) | Number of Rated Proposals | Number of Committee Members | Number of Rated Proposals | Change in Rank Position | | | | | | | | Mean Rank Change | Max. Rank Change | t_s |
|------------------------------|---------------------------|-----------------------------|---------------------------|-------------------------|----|---|----|--------|--------|---------|----------|------------------|------------------|-------|
| | | | | 0 | 1 | 2 | 3 | 4 to 5 | 6 to 7 | 8 to 10 | 11 to 14 | | | |
| A | 46 | 14 | 46 | 8 | 21 | 9 | 3 | 5 | 0 | 0 | 0 | 1.3 | 5 | 0.99 |
| B | 67 | 15 | 67 | 18 | 17 | 4 | 10 | 6 | 8 | 3 | 1 | 2.5 | 14 | 0.98 |
| C | 29 | 12 | 29 | 11 | 7 | 3 | 2 | 5 | 1 | 0 | 0 | 1.4 | 6 | 0.97 |
| D | 16 | 12 | 16 | 10 | 1 | 4 | 1 | 0 | 0 | 0 | 0 | 0.8 | 3 | 0.96 |

Table 10: Changes to rank position through using the coarsened scoring scale when compared to original ranks

| Meeting Period | Data Set | Number of Proposals | Committee Members | Maximum Switch | Number of Switches | Average Switch | Standard Deviation |
|----------------|----------|---------------------|-------------------|----------------|--------------------|----------------|--------------------|
| Period 1 | A | 56 | 8 | 6.5 | 40 | 1.66 | 1.78 |
| | B | 68 | 12 | 10.5 | 58 | 2.01 | 2.01 |
| | C | 22 | 12 | 5 | 11 | 0.64 | 1.15 |
| Period 2 | A | 46 | 14 | 5 | 38 | 1.33 | 1.21 |
| | B | 67 | 15 | 13.5 | 49 | 2.52 | 3.01 |
| | C | 29 | 12 | 5.5 | 18 | 1.38 | 1.57 |
| | E | 16 | 12 | 3 | 6 | 0.75 | 1.06 |
| Period 3 | A | 60 | 10 | 7.5 | 33 | 1.33 | 1.98 |
| | B | 59 | 15 | 6 | 39 | 1.59 | 1.70 |
| | C | 22 | 9 | 2 | 8 | 0.36 | 0.60 |
| | D | 5 | 11 | 0 | 0 | 0.00 | 0.00 |
| | F | 61 | 13 | 12.5 | 31 | 1.90 | 2.78 |
| | G | 40 | 13 | 5.5 | 31 | 1.33 | 1.28 |
| Period 4 | A | 62 | 14 | 7.5 | 39 | 1.50 | 2.08 |
| | B | 75 | 18 | 15.5 | 61 | 3.24 | 3.41 |
| | C | 13 | 12 | 1 | 3 | 0.15 | 0.32 |
| | D | 6 | 13 | 0 | 0 | 0.00 | 0.00 |
| Period 5 | A | 61 | 14 | 6.5 | 36 | 0.93 | 1.31 |
| | B | 102 | 16 | 15 | 81 | 4.31 | 4.46 |
| | D | 12 | 10 | 1 | 2 | 0.17 | 0.39 |
| Period 6 | A | 73 | 12 | 8 | 47 | 2.58 | 2.84 |
| | B | 96 | 19 | 14 | 72 | 3.38 | 4.00 |
| | C | 38 | 12 | 10 | 27 | 2.58 | 2.95 |
| | D | 4 | 12 | 0.5 | 2 | 0.25 | 0.29 |
| Period 7 | A | 83 | 14 | 14.5 | 67 | 3.39 | 3.83 |
| | B | 105 | 17 | 16.5 | 79 | 4.45 | 4.56 |
| | C | 21 | 7 | 3 | 10 | 0.67 | 0.86 |
| | D | 10 | 10 | 0 | 0 | 0.00 | 0.00 |

Table 11: Changes to rank position through using the coarsened scoring scale when compared with original ranks

Table 11 shows, for each of the 28 committees, the number of rank switches, the maximum rank shift, the average rank switch, and the standard deviation of rank shifts when the median score is used for ranking the research proposals. Of interest here are the relationships between:

1. The number of proposals and the number of rank shifts. This is displayed as an X-Y chart in Figure 19.
2. The number of proposals and the maximum rank shift. This is displayed as an X-Y chart in Figure 20.

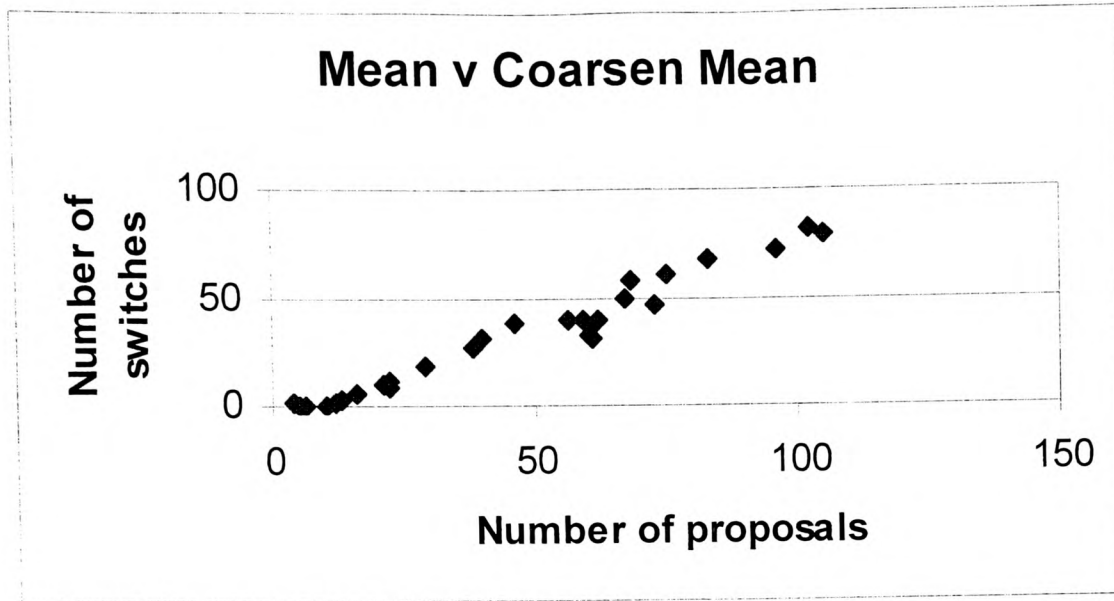


Figure 19: X-Y Chart of number of proposals and number of rank shifts (mean v coarsened mean)

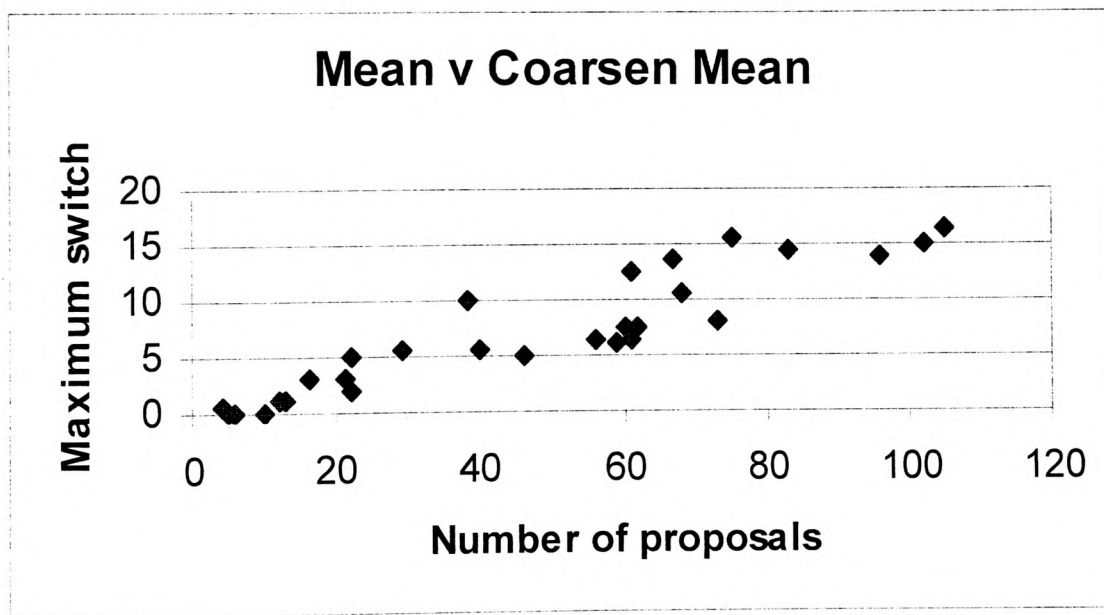


Figure 20: X-Y Chart of number of proposals and maximum rank shift (mean v coarsened mean)

As can be seen in Figure 19 and Figure 20, there appears to be a relationship between the number of proposals, the number of rank shifts and the maximum rank shift, and that as the number of proposals rise, the number of rank shifts and the maximum rank shift will also increase.

These analyses demonstrate that scale change is likely to result in major changes to the rank order in committees using this type of scoring and ranking process.

18.3.4 Effect of the Aggregation Method

Two common methods of preference aggregation are to use the mean score and the median score. In this application, the mean score (for 'Scientific Excellence') has been used to derive the ranked list of research proposals. Therefore it is of interest to compare the rankings produced through use of the median score, which is known to be less affected by extreme or outlying values than the mean. The proposition in this analysis is that:

"The rank ordering of the proposals based on the median scores is the same as the rank ordering of the proposals based on the mean scores".

The ranks obtained from using the mean of the scores and the median of the scores have again been compared using Spearman's Rank-Order Correlation Coefficient r_s . Table 9, sixth column, shows that r_s values for this comparison are again very high for all research committees. All are significant at the 0.01 level (one tailed); indeed, all but those from the three meetings where fewer than 10 proposals were rated are significant at the 0.001 level. However, the same limitations apply to this result as those for the previous proposition,

To further investigate this, a similar analysis to that described in the previous section has been undertaken, this time analysing the changes in rank order position when the median is used instead of the mean for the same four Period 2 committees discussed in the previous section (see Table 12). A study of Table 12 leads to the conclusion that an individual member, who is 'out of line' with other members, can have a significant effect on the ranked positions of individual proposals. The magnitude of the effect demonstrated in Table 12 is of the same order as that due to coarsening the scale, as shown in Table 11.

| Committee Meeting (Period 2) | Number of Rated Proposals | Number of Committee Members | Number of Rated Proposals | Change in Rank Position | | | | | | | | Mean Rank Change | Max. Rank Change | r _s |
|----------------------------------|------------------------------|-----------------------------------|---------------------------------|-------------------------|---|----|---|--------|--------|---------|----------|------------------------|------------------------|----------------|
| | | | | | | | | | | | | | | |
| | | | | 0 | 1 | 2 | 3 | 4 to 5 | 6 to 7 | 8 to 10 | 11 to 14 | | | |
| A | 46 | 14 | 46 | 5 | 6 | 9 | 9 | 7 | 6 | 4 | 0 | 3.2 | 10 | 0.96 |
| B | 67 | 15 | 67 | 6 | 8 | 9 | 6 | 15 | 7 | 10 | 6 | 4.4 | 14 | 0.96 |
| C | 29 | 12 | 29 | 3 | 6 | 13 | 7 | 0 | 0 | 0 | 0 | 1.6 | 3 | 0.98 |
| D | 16 | 12 | 16 | 2 | 7 | 6 | 1 | 0 | 0 | 0 | 0 | 1.0 | 3 | 0.97 |

Table 12: Changes to rank position through using the median when compared with original ranks

The effects of changing the scoring scale and of using the median rather than the mean has also been analysed for the other committee meetings used in this analysis. A summary of these analyses is shown in Table 13.

| Meeting Period | Data Set | Number of Proposals | Committee Members | Maximum Switch | Number of Switches | Average Switch | Standard Deviation |
|----------------|----------|---------------------|-------------------|----------------|--------------------|----------------|--------------------|
| Period 1 | A | 56 | 8 | 9 | 46 | 3.27 | 2.74 |
| | B | 68 | 12 | 19.5 | 68 | 5.63 | 4.88 |
| | C | 22 | 12 | 5 | 22 | 1.86 | 1.54 |
| Period 2 | A | 46 | 14 | 9.5 | 41 | 3.17 | 2.36 |
| | B | 67 | 15 | 14 | 61 | 4.42 | 3.53 |
| | C | 29 | 12 | 3 | 26 | 1.55 | 0.95 |
| | E | 16 | 12 | 2.5 | 14 | 1.00 | 0.68 |
| Period 3 | A | 60 | 10 | 9.5 | 59 | 3.48 | 2.40 |
| | B | 59 | 15 | 10.5 | 56 | 3.78 | 2.77 |
| | C | 22 | 9 | 2.5 | 18 | 1.27 | 0.92 |
| | D | 5 | 11 | 0.5 | 4 | 0.40 | 0.22 |
| | F | 61 | 13 | 15.5 | 59 | 4.97 | 3.86 |
| | G | 40 | 13 | 9 | 37 | 3.15 | 2.60 |
| Period 4 | A | 62 | 14 | 10 | 57 | 3.77 | 2.78 |
| | B | 75 | 18 | 17 | 74 | 5.15 | 4.29 |
| | C | 13 | 12 | 4 | 11 | 1.77 | 1.38 |
| | D | 6 | 13 | 1 | 4 | 0.50 | 0.45 |
| Period 5 | A | 61 | 14 | 17.5 | 58 | 4.82 | 3.79 |
| | B | 102 | 16 | 20.5 | 101 | 7.15 | 5.62 |
| | D | 12 | 10 | 2.5 | 10 | 1.25 | 0.89 |
| Period 6 | A | 73 | 12 | 13.5 | 71 | 4.93 | 3.36 |
| | B | 96 | 19 | 22 | 95 | 6.27 | 5.16 |
| | C | 38 | 12 | 6.5 | 36 | 2.45 | 1.82 |
| | D | 4 | 12 | 0.5 | 2 | 0.25 | 0.29 |
| Period 7 | A | 83 | 14 | 23.5 | 81 | 5.67 | 4.26 |
| | B | 105 | 17 | 23.5 | 102 | 7.54 | 6.54 |
| | C | 21 | 7 | 4 | 14 | 1.29 | 1.29 |
| | D | 10 | 10 | 2 | 8 | 1.00 | 0.71 |

Table 13: Changes to rank position through using the median when compared with original ranks

Table 13 shows, for each of the 28 committees, the number of rank switches, the maximum rank shift, the average rank switch, and the standard deviation of rank shifts. Of interest here are the relationships between:

1. The number of proposals and the number of rank shifts. This is displayed as an X-Y chart in Figure 21.

2. The number of proposals and the maximum rank shift. This is displayed as an X-Y chart in Figure 22.

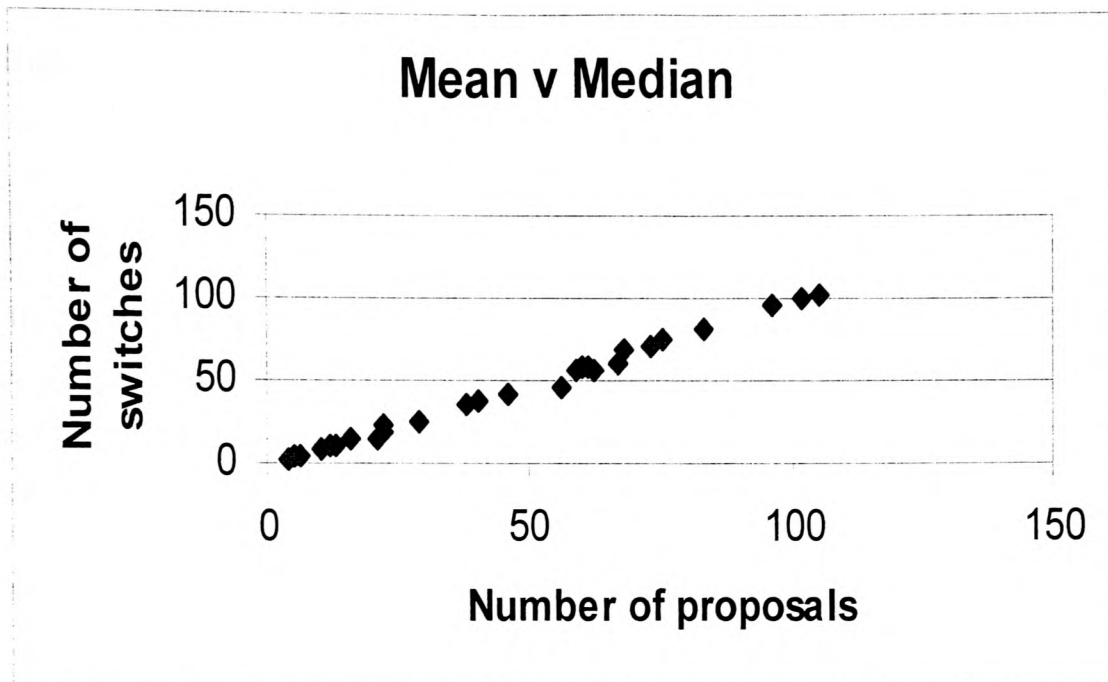


Figure 21: X-Y Chart of number of proposals and number of rank shifts (mean v median)

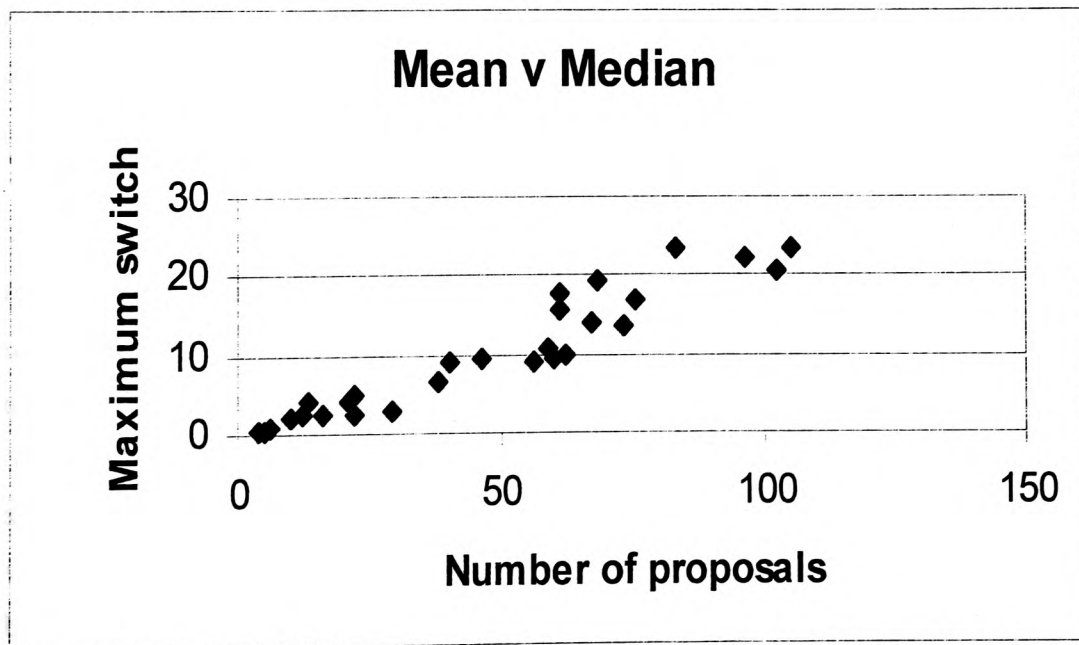


Figure 22: X-Y Chart of number of proposals and maximum rank shift (mean v median)

As can be seen in Figure 21 and Figure 22 there appears to be a strong relationship between the number of proposals, the number of rank shifts and the maximum rank

shift, and that as the number of proposals rise, the number of rank shifts and the maximum rank shift will also increase.

These analyses demonstrate that there can be large rank changes if using the median rather than the mean score, and the size and number of rank shifts is likely to increase as the number of proposals increase. This could again lead to consequent changes to the set of proposals selected for funding.

18.3.5 Effect of Disregarding One Member's Scores

A possibility that may occur is that of the rejection of a proposal principally because of the opinion of one committee member: the converse could also apply, in that a proposal could be approved because of strong support from one committee member.

An individual committee member's opinion on the decision about a particular proposal may have an effect in two ways: contributions to discussion, and the actual score given. Only the latter of these is considered here. The influencing effect of a committee member's contribution to discussion, especially where that person is one of the nominated presenters for a proposal, is not something that can be investigated with the data available. However, the effect of one committee member's scores on the overall scores and rankings can be examined.

This section explores the effect of any individual committee member's opinion on the ranked order of proposals, exemplifying Period 2, Committee B data set. This analysis is undertaken by taking out the scores of each individual committee member from the aggregating process and reviewing any changes in ranks. It was initially felt that 'outliers' (i.e. those members who score out of line from other members) might have a significant effect on the ranked order of proposals. Therefore an initial 'null hypothesis' was formulated to test whether taking out the scores of a committee member judged to be an 'outlier' would have a significant effect on the ranked list of proposals.

Following these initial analyses, it was decided to extend this analysis to include taking out all committee member scores one by one, and observing any changes in the rankings produced. It should be noted here that, in terms of these analyses, the issue of significance is judgemental. The analyses above have tested the significance of various

factors on the rank order produced by the committees through the use of Spearman's rank order correlation coefficient. No statistically significant effects have been found, however changes in rank position for individual proposals can be identified. These changes in rank position, although not statistically significant, could result in different management decisions being made as to which proposals were selected for funding and could affect the quality of the decisions made at the committee meetings.

Identification of Outliers

As a first step in these analyses, the committee members judged to be outliers had to be identified. A visual method was developed that involved colour coding each score for each of the 15 individual committee members on the following basis:

- a) Score of 5 - Dark Blue
- b) Score of 4 - Red
- c) Score of 3 - Light Blue
- d) Score of 2 - Green
- e) Score of 1 - Yellow
- f) No score - White

The result of this colour coding is shown in Annex 1 to this project. Using this visual method, it would appear that committee member 4 tends to score below those of his/her colleagues, and committee member 14 appears to score higher than his/her colleagues. This visual method is supported by an analysis of the number of times each committee member scores higher, equal to, or lower than the median score for a particular proposal. Table 14 shows the member scoring when compared to the median. Committee member 4 has scored below the median 37% of the time, while committee member 14 has scored above the median for 30% of the time.

| Committee Member | No score | Under median | Equal to median | Greater than median |
|------------------|----------|--------------|-----------------|---------------------|
| No. 1 | 0 | 5 | 82 | 13 |
| No. 2 | 0 | 24 | 67 | 9 |
| No. 3 | 2 | 15 | 79 | 4 |
| No. 4 | 3 | 37 | 51 | 9 |
| No. 5 | 4 | 7 | 84 | 5 |
| No. 6 | 3 | 4 | 75 | 18 |
| No. 7 | 6 | 1 | 84 | 9 |
| No. 8 | 7 | 3 | 82 | 8 |
| No. 9 | 3 | 9 | 82 | 6 |
| No.10 | 13 | 18 | 61 | 8 |
| No.11 | 2 | 13 | 78 | 7 |
| No.12 | 1 | 21 | 70 | 7 |
| No.13 | 40 | 7 | 48 | 5 |
| No.14 | 2 | 1 | 67 | 30 |
| No.15 | 5 | 13 | 79 | 3 |

Table 14: Member scoring compared to median scores (%) (Period 2 Committee B)

Analyses of taking out individual committee member's opinion on the ranked order of proposals

Having undertaken an initial analysis with the identified outliers (judged to be committee members 4 and 14), it was decided to extend the analyses for all committee members. Therefore the analyses undertaken for all committee members (whether outliers or not) are presented here together.

The research question that taking out the scores of a single committee member would have a significant effect on the ranked positions of proposals is considered here. This issue was tested by taking out the scores of each individual committee member, one by one, from the mean score (the aggregation method that was used to produce the rank order) and the median score. Results of these analyses are shown in Table 15 and Table 16. Table 15 displays the effect on the rank order of taking out the scores of each committee member one by one, using both the mean and the median. Information displayed in Table 15 are: Rank Shifts Greater Than One (the number of times a proposal shifted rank by more than one position); Maximum Rank Shift (the greatest shift in rank of any proposal); Mean Rank Shift; and Standard Deviation of Rank Shifts.

Table 16 displays, for each of the 67 proposals, the number of times that the withdrawal of a committee member's scores have resulted in a change of rank of more than one position.

| Member number | Mean Analyses | | | | Median Analyses | | | |
|---------------|------------------------------|---------------------|------------------|--------------------|------------------------------|---------------------|------------------|--------------------|
| | Rank Shifts greater than one | Maximum Rank Change | Mean Rank Change | Standard Deviation | Rank Shifts greater than one | Maximum Rank Change | Mean Rank Change | Standard Deviation |
| 1 | 8 | 2.5 | 0.43 | 0.72 | 3 | 12.5 | 0.57 | 1.85 |
| 2 | 24 | 4 | 0.96 | 0.96 | 2 | 9 | 0.45 | 1.30 |
| 3 | 6 | 4.5 | 0.43 | 0.81 | 3 | 13 | 0.82 | 1.93 |
| 4 | 15 | 5.5 | 0.84 | 1.26 | 5 | 14 | 1.00 | 2.65 |
| 5 | 6 | 3 | 0.46 | 0.70 | 4 | 14 | 0.85 | 2.62 |
| 6 | 4 | 3 | 0.36 | 0.64 | 3 | 13 | 0.82 | 1.94 |
| 7 | 0 | 1 | 0.12 | 0.29 | 4 | 12.5 | 0.84 | 2.25 |
| 8 | 3 | 2 | 0.18 | 0.44 | 3 | 13 | 0.58 | 1.92 |
| 9 | 12 | 4 | 0.63 | 0.90 | 4 | 13.5 | 0.84 | 2.56 |
| 10 | 8 | 3.5 | 0.51 | 0.68 | 3 | 8.5 | 0.45 | 1.50 |
| 11 | 4 | 4.5 | 0.42 | 0.72 | 4 | 8.5 | 0.63 | 1.65 |
| 12 | 9 | 3.5 | 0.55 | 0.81 | 4 | 13 | 0.97 | 1.99 |
| 13 | 6 | 2.5 | 0.54 | 0.62 | 2 | 9 | 0.45 | 1.30 |
| 14 | 4 | 3 | 0.49 | 0.67 | 3 | 12.5 | 0.82 | 1.91 |
| 15 | 9 | 3.5 | 0.57 | 0.84 | 4 | 13.5 | 0.69 | 2.79 |

Table 15: Member Analyses: The effect on the rank order of taking out the scores of each committee member one by one (Period 2, Committee B)

| Proposal Number | Mean Rank shifts greater than one | Median Rank shifts greater than one | Proposal Number | Mean Rank shifts greater than one | Median Rank shifts greater than one |
|-----------------|--|--|-----------------|--|--|
| 1 | 0 | 0 | 35 | 2 | 0 |
| 2 | 4 | 0 | 36 | 0 | 0 |
| 3 | 2 | 0 | 37 | 0 | 0 |
| 4 | 5 | 7 | 38 | 4 | 0 |
| 5 | 1 | 0 | 39 | 4 | 0 |
| 6 | 1 | 0 | 40 | 0 | 0 |
| 7 | 2 | 8 | 41 | 0 | 0 |
| 8 | 1 | 0 | 42 | 4 | 0 |
| 9 | 0 | 0 | 43 | 0 | 0 |
| 10 | 0 | 0 | 44 | 4 | 0 |
| 11 | 4 | 0 | 45 | 0 | 0 |
| 12 | 1 | 0 | 46 | 2 | 0 |
| 13 | 0 | 0 | 47 | 3 | 14 |
| 14 | 4 | 0 | 48 | 0 | 0 |
| 15 | 0 | 8 | 49 | 5 | 0 |
| 16 | 0 | 0 | 50 | 1 | 0 |
| 17 | 0 | 0 | 51 | 0 | 0 |
| 18 | 0 | 0 | 52 | 2 | 0 |
| 19 | 0 | 0 | 53 | 5 | 0 |
| 20 | 0 | 0 | 54 | 0 | 0 |
| 21 | 0 | 14 | 55 | 0 | 0 |
| 22 | 11 | 0 | 56 | 5 | 0 |
| 23 | 4 | 0 | 57 | 2 | 0 |
| 24 | 3 | 0 | 58 | 2 | 0 |
| 25 | 1 | 0 | 59 | 0 | 0 |
| 26 | 3 | 0 | 60 | 1 | 0 |
| 27 | 0 | 0 | 61 | 3 | 0 |
| 28 | 1 | 0 | 62 | 2 | 0 |
| 29 | 0 | 0 | 63 | 3 | 0 |
| 30 | 4 | 0 | 64 | 0 | 0 |
| 31 | 2 | 0 | 65 | 0 | 0 |
| 32 | 0 | 0 | 66 | 2 | 0 |
| 33 | 2 | 0 | 67 | 3 | 0 |
| 34 | 3 | 0 | | | |

Table 16: Proposal Analyses: The effect on the rank order of taking out the scores of each committee member one by one (Period 2, Committee B)

An examination of Table 15 and Table 16 demonstrates that:

- Disregarding the scores from an outlier may have a significant effect on the ranking for some proposals but not others.

- Disregarding the scores from any group member may have a significant effect on ranked positioning for some proposals but not others – and this effect may be as large as that identified when disregarding an outlier. Disregarding any group member will result in different rank changes for different proposals.
- Different results have been obtained for the mean and median analyses. When using the mean for ranking, there are changes of rank for many proposals (40 out of 67 proposals change rank by more than one position at least once, when taking out each group member). However, the absolute rank change is relatively small – the maximum rank change is 5.5 positions. However, when using the median, there are much less occasions when a proposal changes rank by at least one position (only 5 proposals change rank by at least one position), but the rank change can be very large (up to 13.5 positions) and for these proposals it is shown that any group member can significantly affect the ranking.

These analyses have been repeated for all of the other meetings and a summary of these analyses is shown in Table 17. This table displays, for both mean and median analyses, the number of members where at least one rank shift is greater than one position, the maximum rank shift obtained, and the percentage of proposals that change rank by more than one position, following a member's score being disregarded. Rank position changes may occur when both the mean and the median are used as the ranking method, but the median rank position changes are generally (but not always) greater than the mean rank changes. Also, the proportion of proposals that may change ranked positions following a member's score being disregarded is generally (but not always) greater when the mean is used as the ranking method.

| Meeting Period | Data Set | Number of Members | Number of Proposals | Mean Analyses | | | Median Analyses | | |
|----------------|----------|-------------------|---------------------|--|--------------------|--|--|--------------------|--|
| | | | | Number of Members with a Rank Shift Greater Than One | Maximum Rank Shift | Percentage of Proposals with a Rank Shift Greater Than One | Number of Members with a Rank Shift Greater Than One | Maximum Rank Shift | Percentage of Proposals with a Rank Shift Greater Than One |
| Period 1 | A | 8 | 56 | 8 | 8 | 55% | 8 | 11 | 50% |
| | B | 12 | 68 | 12 | 11 | 85% | 12 | 17.5 | 10% |
| | C | 12 | 22 | 11 | 4.5 | 73% | 5 | 5 | 5% |
| Period 2 | A | 14 | 46 | 14 | 7 | 43% | 14 | 11.5 | 15% |
| | B | 15 | 67 | 14 | 5.5 | 60% | 15 | 13.5 | 7% |
| | C | 12 | 29 | 4 | 2.5 | 17% | 12 | 3.5 | 7% |
| | E | 12 | 16 | 1 | 2 | 6% | 12 | 3.5 | 13% |
| Period 3 | A | 10 | 60 | 10 | 10.5 | 82% | 10 | 11 | 65% |
| | B | 15 | 59 | 14 | 4.5 | 68% | 15 | 7.5 | 19% |
| | C | 9 | 22 | 3 | 1.5 | 18% | 9 | 3 | 14% |
| | D | 11 | 5 | 0 | 0 | 0% | 0 | 0.5 | 0% |
| | F | 13 | 61 | 13 | 9.5 | 79% | 13 | 14 | 10% |
| | G | 13 | 40 | 13 | 5.5 | 65% | 13 | 9.5 | 55% |
| Period 4 | A | 14 | 62 | 14 | 7.5 | 71% | 14 | 10 | 39% |
| | B | 18 | 75 | 18 | 5.5 | 69% | 18 | 16.5 | 11% |
| | C | 12 | 13 | 4 | 2.5 | 38% | 12 | 3.5 | 0% |
| | D | 13 | 6 | 0 | 1 | 0% | 0 | 1 | 0% |
| Period 5 | A | 14 | 61 | 14 | 5.5 | 67% | 14 | 14 | 49% |
| | B | 16 | 102 | 16 | 9 | 83% | 16 | 22.5 | 20% |
| | D | 10 | 12 | 0 | 1 | 0% | 5 | 2.5 | 8% |
| Period 6 | A | 12 | 73 | 12 | 9.5 | 67% | 11 | 14.5 | 7% |
| | B | 19 | 96 | 19 | 7.5 | 63% | 19 | 20.5 | 45% |
| | C | 12 | 38 | 9 | 3.5 | 55% | 12 | 7.5 | 45% |
| | D | 12 | 4 | 0 | 0.5 | 0% | 0 | 0.5 | 0% |
| Period 7 | A | 14 | 83 | 14 | 8.5 | 70% | 14 | 17.5 | 24% |
| | B | 17 | 105 | 17 | 6 | 79% | 17 | 25.5 | 9% |
| | C | 7 | 21 | 4 | 3 | 29% | 7 | 6.5 | 33% |
| | D | 10 | 10 | 0 | 1 | 0% | 5 | 1.5 | 10% |

Table 17: Summary Table of Rank Shifts when a Member's Scores are Disregarded

A study of Table 17 demonstrates that disregarding the scores of a group member (and not necessarily a perceived outlier) can have a significant effect on the final rankings produced, and this effect may differ when using either the mean or the median as the aggregation method for deriving the rankings.

19 Discussion of Project Two

This project has involved an action research approach concerned with the development and implementation of the Teamworker GSS with a public-sector Research Award Body, and the continued use of the system by the Award Body over a 5-year period to enable Research Committees to rank research proposals. The project has included the evaluation of the GSS from two different perspectives:

1. Evaluation of the usefulness of the Teamworker GSS from the perspective of the Award Body
2. Evaluation of the process used to rank research proposals, in terms of the robustness of the funding decisions made

It would appear that Award Body Officers were extremely satisfied with the Teamworker GSS. The system was utilised continuously over a five-year period to support ranking of research proposals by each of the Research Committees. Award Body Officers found that the system was extremely useful as it:

- Made their life easier
- Helped committee members become more consistent in their scoring.
- Stopped domination by the few
- Enabled the agenda to be completed in the time available

The reactions of the members of the Research Committees were more varied, however the members of the Research Committees did accept the system, and it was used continuously by the different Research Committees over a five-year period, and until the functions of Award Body were taken over by another institution.

However, the evaluation of the process does give cause for concern. The data relating to 28 separate committees meeting over a number of years have been analysed. The committees ranged in size from 7 to 19 members and the number of proposals ranked by each committee was in the range 4 to 105.

Data from the individual member scores has been used to assess the impact of 'Position in Agenda' and the 'Financial Value of the Proposal' of each proposal in the sets of data analysed. The conclusion in connection with the first of these issues (Position in Agenda) is that rank orders are unlikely to be significantly affected.

For the second of these issues (Financial Value of the Proposal) the rank order does appear to be correlated for a small number of the committees but there does not appear to be any overall pattern or systematic effect. The one significant negative correlation was for Committee B in Period 4, but this committee had a significant positive correlation in Period 2. Committee A had two significant positive correlations, but also had three negative correlations that were not significant at the 0.05 level of significance. Committees C and F had one significant positive correlation each (admittedly one out of one in the case of F).

Of more significance, however, data from the individual member scores has also been used to assess the significance of the "Scoring System Used" in terms of coarsening the 5 point scale to 3 points and of the use of the median rather than the mean as the ranking method. In both these cases, a statistical analysis using rank correlation showed very high rank correlations between the original and the modified rankings.

However, a closer investigation of the data, concentrating attention on the changes in ranked positions of individual proposals, is more interesting. Using actual committee data, it can be shown that major changes in ranked order can result from different methods of aggregating individual inputs to produce group rankings. In particular, major changes in the rank positions can result from changing the scoring scale used and from using the median rather than the mean as the method of producing an aggregate score for a proposal. The effects of the rank order changes that are demonstrated are important to the quality of the decisions reached by the committees, although the rank correlation coefficients are impressively high. Either of these changes to the design of the scoring process may result in changes to the sets of proposals selected for funding.

Additionally, the effect of disregarding one member's scores has been analysed. Examination of these results suggests that disregarding a member's score, and not necessarily a member perceived to be an outlier, can result in large rank switches. This

effect will differ depending upon whether the mean or the median is used as an aggregation method to derive the ranked list of proposals, however the effects are such that changes in the set of proposals selected for funding could result.

The main design objectives of the Teamworker GSS was to enable the Research Committees to give funding advice to the Award Body Central Office in a relatively short period of time, and to reduce domination by a few committee members. The outputs from this application (particularly the opinions of the Award Body Officers) suggest that these design objectives were successfully met. However, despite the apparent usefulness of the Teamworker system from the viewpoint of the Award Body Officers, the process used to make funding decisions is not very robust, as different funding decisions may have been made if different scoring scales or aggregation methods had been used, or if an individual committee member's score for a proposal was disregarded.

From a personal perspective, I believe that a problem with the process was the amount of time given to discussion of the inputs at each stage of the process. One of the reasons for using a GSS is to enable differences of opinion to be identified and discussed in a non-threatening environment. However, the members of the Research Committees had very little time to discuss a proposal following feedback of the scoring of a particular proposal – even when there appeared to be a great deal of disagreement within the committee. A reason that so little time was allowed for discussion was the large number of proposals that each committee had to consider at each meeting.

The effect of this limited discussion time is decreased robustness of the funding decisions made through the process. If additional time had been allowed for discussion of the scores at each stage of the scoring process, and re-scoring of proposals when disagreement was apparent, it is likely that the committees would have run out of time to consider all proposals. The discussion of the scores following feedback of the scores on a large screen may support a reduction in the variability of individual scores for each proposal (see, for example, Read *et al*, 2003, and discussed more fully in Project 3 of this portfolio). Any reduction in variability is likely to improve the robustness of the process, in terms of scoring scales used, methods of aggregation and membership of the committee.

However, it is recognised that, in this particular context, it would be very difficult to ensure sufficient time for adequate discussion to take place due to the number of research proposals that had to be considered at each meeting. Nevertheless, all participants, and any others who use similar methods for ranking items should have understood the lack of robustness of the ranking method. There is also still a need for further research to address the issues of developing scales of appropriate fineness in terms of scale points, and of selecting the method of aggregating member scores for committees engaged on this type of task.

20 Annex 1 to Chapter 3 – Colour coding of member scores (Period 2, Committee B)

| Rank | Sequence | Mean | Median | Mode | No.1 | No. 2 | No. 3 | No. 4 | No. 5 | No. 6 | No. 7 | No. 8 | No. 9 | No.10 | No.11 | No.12 | No.13 | No.14 | No.15 |
|------|----------|-------|--------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1 | 36 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 2 | 55 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 3 | 40 | 4.786 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 4 | 59 | 4.692 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 5 | 16 | 4.667 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 6 | 27 | 4.333 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 7 | 54 | 4.154 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 8 | 33 | 4.077 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 9 | 12 | 4.071 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 10 | 25 | 4.071 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 11 | 66 | 4.071 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 12 | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 13 | 9 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 14 | 31 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 15 | 41 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 16 | 51 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 17 | 61 | 3.933 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 18 | 57 | 3.929 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 19 | 62 | 3.929 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 20 | 2 | 3.867 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 21 | 24 | 3.867 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 22 | 30 | 3.867 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 23 | 56 | 3.857 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 24 | 67 | 3.857 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 25 | 50 | 3.846 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 26 | 34 | 3.786 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 27 | 52 | 3.786 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 28 | 10 | 3.714 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 29 | 64 | 3.643 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 30 | 7 | 3.533 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 31 | 47 | 3.5 | 3.5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 32 | 4 | 3.462 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 33 | 22 | 3.462 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 34 | 11 | 3.429 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 35 | 53 | 3.429 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 36 | 5 | 3.143 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 37 | 19 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

[illegible]

CHAPTER FOUR

PROJECT THREE

USING A GROUP SUPPORT SYSTEM TO AID DEVELOPMENT OF PROFESSIONAL JUDGEMENT

21 Introduction to Project Three

This project is based upon the implementation of the Teamworker GSS to support the training of Norwegian social services personnel in the use of a standardised framework known as Gerix, which is used for the assessment of social services clients. The Gerix framework has been in development since 1990, and is a joint project of the Ministries of Local Affairs, Social and Health Services, the Norwegian Department of Statistics, and regional municipalities. The implementation began with set of trials comprising a series of four one-day meetings with panels of members from each of four different Norwegian municipalities. Data and information from these initial trials were captured to evaluate the usefulness of the GSS in this context.

Subsequently, the Teamworker GSS was adopted as a support tool for the training of social services personnel in the use of the Gerix methodology, and the system has now been used to train a number of groups throughout Norway over a period of five years. Participants consider 'standard' cases, for which the correct assessments are known, but not by the members of the groups. The availability of this data, unusual outside of a laboratory experimental approach, allows measurement of the efficacy of this approach to professional development.

Additionally, on the basis of the support for groups training to use the Gerix methodology in Norway, the Teamworker GSS has been implemented to support training groups in Denmark where a standardised framework similar to the Gerix framework has been adopted.

This project reviews the implementation of the Teamworker GSS as a support tool for the professional judgement training of social services personnel in the use of the Gerix framework, and the evaluation of the Teamworker GSS, both during the initial trials and the subsequent adoption of the system for training in the Gerix methodology.

21.1 Objectives of Project Three

The objectives of this project are:

1. Using an Action Research approach, discuss the development and implementation of the Teamworker GSS for use with groups training to use the Gerix framework.
2. Evaluate the group process in terms of the range of assessments produced and the effect of the initial group majority (process centred evaluation approach).
3. Evaluate the type of learning achieved through use of the GSS and associated group process during the initial trials (output evaluation approach).
4. Evaluate the degree to which individual participants move closer to the known 'correct' scores (output evaluation approach).
5. Evaluate the value of the technology using feedback of participating group members and the Project Manager charged with organising the training in the use of Gerix (people centred evaluation approach).
6. Discuss the significance of this evaluation in terms of GSS design effectiveness.

22 Background to the Project

The application of the Teamworker GSS reviewed in this project is concerned with the introduction within Norway of an approach to the gathering and subsequent utilisation of information relating to recipients of nursing, rehabilitation and other care services in each locality (known as municipalities). The approach, called Gerix, has been developed by the Ministry of Social and Health Services, the Norwegian Department of Statistics (Statistics Norway), and regional municipalities. The purpose of the framework is to provide a national information and decision support system containing information about the state and situation for social care clients and the level of care services given to each client. The information produced through use of the Gerix framework support both central government and the municipalities by describing the level of needs of different categories of clients both nationally and in local municipalities. Strategic decisions can then be made on the level of funding that should be made available to support various categories of social care clients.

The framework focuses on the routine adoption and use of a registration document. This contains the information relating to each recipient in terms of their strengths and impairments in various activities involved in daily living.

The document allows a client review, and professional judgements to be reached on a set of variables concerned with physical capabilities, cognitive and psycho-social functioning. Part of the form also provides for more factual information relating to their residential situation, social network, and assistance received at present, to be detailed. This information is entered into a database for use by local staff in the social services, as well as by administrators and policy makers at both local and national levels in their efforts to distribute care resources according to needs and with equity.

The registration document is shown in Annex 1 to this project. This case study focuses on the 17 variables concerned with functional capability, as identified in Table 18.

| Number | Description | Gerix Variable Number (see Annex 1 to this Chapter) |
|--------|--------------------------------------|--|
| 1 | Ability to move indoors | 21 |
| 2 | Ability to move outdoors | 22 |
| 3 | Personal hygiene | 23 |
| 4 | Dressing/Undressing | 24 |
| 5 | Toilet functions | 25 |
| 6 | Eating | 26 |
| 7 | Shopping | 27 |
| 8 | Cooking/Preparation of food | 28 |
| 9 | Cleaning | 29 |
| 10 | Personal Medical Care | 30 |
| 11 | Orientation Ability | 31 |
| 12 | Self-Perception of own situation | 32 |
| 13 | Feeling of security | 33 |
| 14 | Ability to socialise | 34 |
| 15 | Ability to take initiative | 35 |
| 16 | Responsibility for own everyday life | 36 |
| 17 | Communication ability | 37 |

Table 18: Gerix variables concerned with functional capability

These 17 variables correspond to items numbered 21 through 37 on the sample Gerix Registration Document (Annex 1). For a given client, each variable requires an input that depends upon professional judgement, in terms of a client's ability to perform

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| 8 | Cooking/Preparation of food | 28 |
| 9 | Cleaning | 29 |
| 10 | Personal Medical Care | 30 |
| 11 | Orientation Ability | 31 |
| 12 | Self-Perception of own situation | 32 |
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| 14 | Ability to socialise | 34 |
| 15 | Ability to take initiative | 35 |
| 16 | Responsibility for own everyday life | 36 |
| 17 | Communication ability | 37 |

Table 18: Gerix variables concerned with functional capability

These 17 variables correspond to items numbered 21 through 37 on the sample Gerix Registration Document (Annex 1). For a given client, each variable requires an input that depends upon professional judgement, in terms of a client's ability to perform

normal activity and daily life (known as ADL). The Gerix model allows this judgement to be made on a 4 point scale, where each point is defined as follows:

- 1 - Completely independent of help
- 2 - Independent to some extent
- 3 - Dependent on help to some extent
- 4 - Completely dependent on help

There are about 400 municipalities covering Norway, and the use of the Gerix framework to deliver data on care recipients has now become compulsory for all municipalities. A crucial aim of the approach is to provide care on an equable basis across the Nation. This demands that the model is used and interpreted in a consistent way by social workers in every municipality. However, because the 17 variables depend on professional judgements, there is an important requirement to train users and test that all those involved are using the model consistently. The users of the model come from a wide range of professional backgrounds ranging from care assistants, social workers, community nurses, through to psychologists, general practitioners and medical consultants.

The organisation given responsibility by the Ministry of Social Affairs and Health for organising training in the use of Gerix in the different municipalities is known as TeamStandards AS, headed by Rune Devold. Rune Devold, a manager with a great deal of experience in Norwegian public services, was the project manager for the initial organisation of the training, and he was concerned to find a way to encourage consistency of interpretation of the Gerix framework by all the individual personnel that were required to be trained. It was decided to explore the feasibility and desirability of utilising group interactive training methods for this training, through the use of a GSS, to enable participants in a training session to share their judgements with others in a non-threatening environment, discuss these judgements, and through this process provide a learning experience in the Gerix framework. Professor Gear and myself were therefore invited to trial the Teamworker GSS with groups of personnel in four separate municipalities, each of whom who had some understanding on the Gerix framework.

23 Initial Trials Using Teamworker

The design objectives of the Teamworker GSS in this application were to use the GSS to encourage participants in a training session to share their judgements with others in an environment with reduced domination effects from higher status members, to provide opportunities to discuss these judgements, and through this process provide a learning experience in the Gerix framework to improve professional judgement.

A series of four one day meetings with panels of members from each of four different municipalities was organised. Four different municipalities were used (rather than four experiments in one municipality) to identify any regional differences in how the GSS was perceived. Each panel consisted of a mixed group of professionals from medical, nursing and social work backgrounds. This ensured that a broad range of different professions who are involved in the application of Gerix were involved in the trials. Each panel reviewed a set of actual clients (care recipients) on the 17 variables, on a client by client basis. Each panel member had been through a Gerix training course and also knew each of the clients that were to be assessed, although to varying degrees of knowledge. Table 19 gives information on the municipalities involved with the trials, the size of each panel, and the number of clients scored.

| Trial | District | Population | Panel Size | Number of Clients Scored |
|--------------|--|-------------------|-------------------|---------------------------------|
| 1 | Eidsvoll (near Oslo) | 12,000 | 6 | 12 |
| 2 | Trondheim, Central District | 30,000 | 10 | 7 |
| 3 | Oslo, Uranienborg-Majororstuen District, Upper Section | 25,000 | 7 | 10 |
| 4 | Oslo, Uranienborg-Majororstuen District, Lower Section | 25,000 | 8 | 6 |

Table 19: Information on Municipalities used for Initial Trials

One of the panellists was nominated as the panel leader, who chaired the session and ensured that all panellists had the opportunity to contribute to the panel discussions. The panel leader also selected the panel members and the clients that were to be discussed by each panel. Only the panel leader was aware of the particular clients to be analysed in advance.

The meeting room was arranged to ensure that all participants could see and talk to each other naturally as well as being able to easily view the large screen display used by Teamworker. Figure 23 illustrates the meeting room layout typically used.

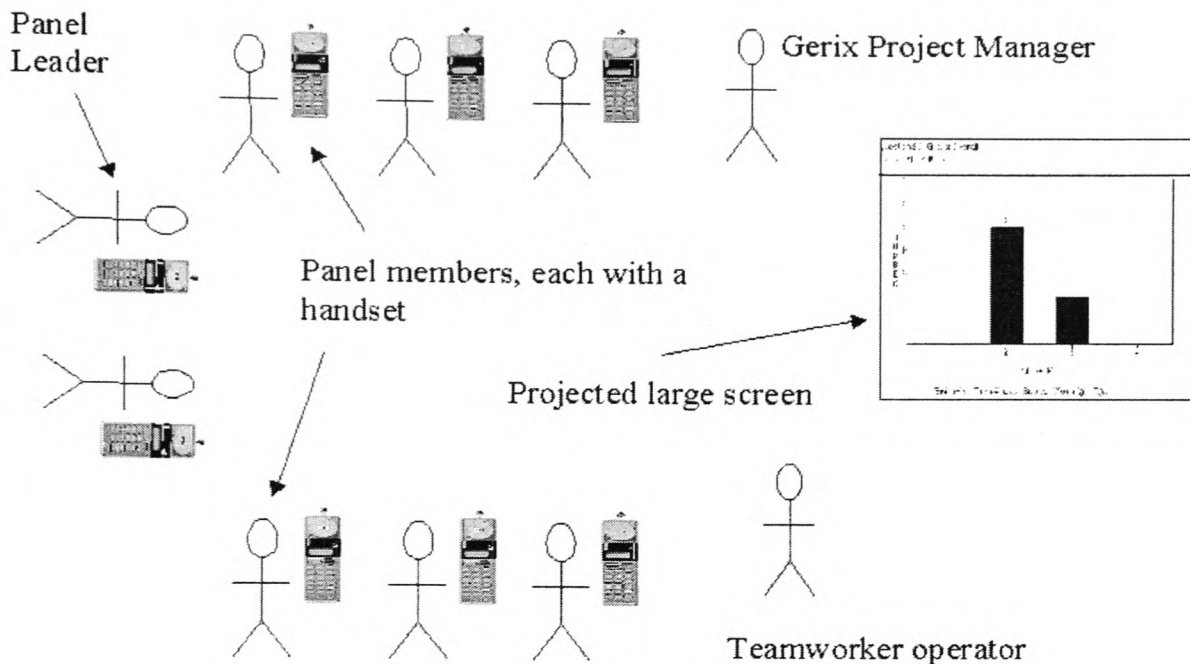


Figure 23: Typical Meeting Room Layout

The panel meetings used slightly different processes, as we experimented to identify the most effective way of using the Teamworker GSS in this context. By Day 3, a standard process, divided into four separate stages, had been agreed:

23.1 Stage 1 – Introduction to the Panel Session

The initial stage consisted of making the panel members comfortable, explaining the purpose of the meeting, describing the purpose of the Teamworker technology and how it was to be used, and explaining the role that myself and others concerned with the trials would play. This introduction to the meeting was given by the Gerix Project Manager. He explained to the group the problem of requiring consistent assessment of the Gerix criteria, and described the objective of the meeting as:

“to let the staff attending the meeting use their present skills to directly assess specific clients and have their differences documented. Then give the panel members the opportunity to discuss the Gerix variables and facts about the clients, and then see what changes have occurred, and why, through reassessment.”

Not all panel members were ‘computer literate’ and there was some initial concern by some individuals about whether they would be able to use the Teamworker handsets. However these concerns soon dissipated as soon as the first responses using the handsets were requested. Thereafter the handsets became a tool to allow disagreements to be easily illustrated and discussed, and did not otherwise impinge on the meeting.

23.2 Stage 2 – Introduction to the Teamworker GSS

The second stage involved asking the panel members to use the handsets to enter personal information, such as occupation, age, and years of Gerix experience. This stage served as a straightforward introduction to the Teamworker system for the panel members.

23.3 Stage 3 – Rating of Clients using Teamworker GSS

In the third stage, each of the selected clients was considered in turn. Each of the clients was already known to all of the panel members, but to varying degrees of knowledge. The Process Model used is shown in Figure 24.

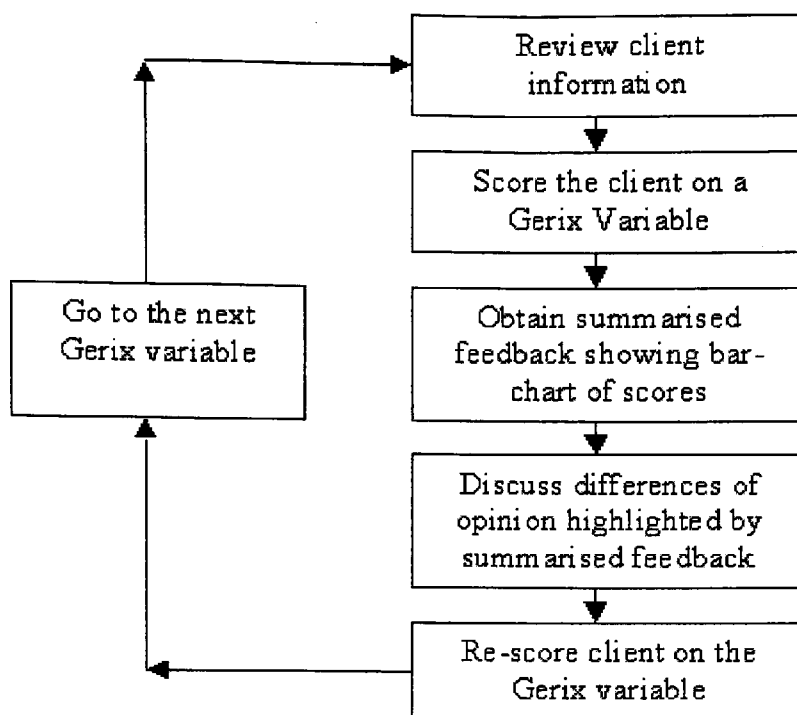


Figure 24: Process Model Used for Initial Trials

After being told the name of each client that had been chosen to be considered by the panel leader, each panel member scored the client on each of the 17 variables (numbered 21 to 37) using the radio handsets. Figure 25 illustrates a Teamworker screen shown on the large display that asks panel members to score the first client on variable 23 (Personal Hygiene). Once the scores had been collected by the Teamworker system, a bar chart of scores was presented back to the group on the large screen for further discussion. This feedback screen is shown in Figure 26 and shows that five members have scored this client/variable mix as “2” (independent to some extent), and two members have scored “3” (dependent on help to some extent). The bar chart of scores often demonstrated differences of opinions within the group. These differences of opinion were discussed by the group, after which the client could be re-scored at the discretion of the panel leader or project manager. This particular client/variable mix was re-scored, and the resulting feedback bar chart is shown in Figure 27.

Personlig hygiene

Gi din score

verdi 1 - 4

Q. 23

1 2 3 4 5 6 7

Figure 25: Teamworker Question Screen - Variable 23 (Personal Hygiene)

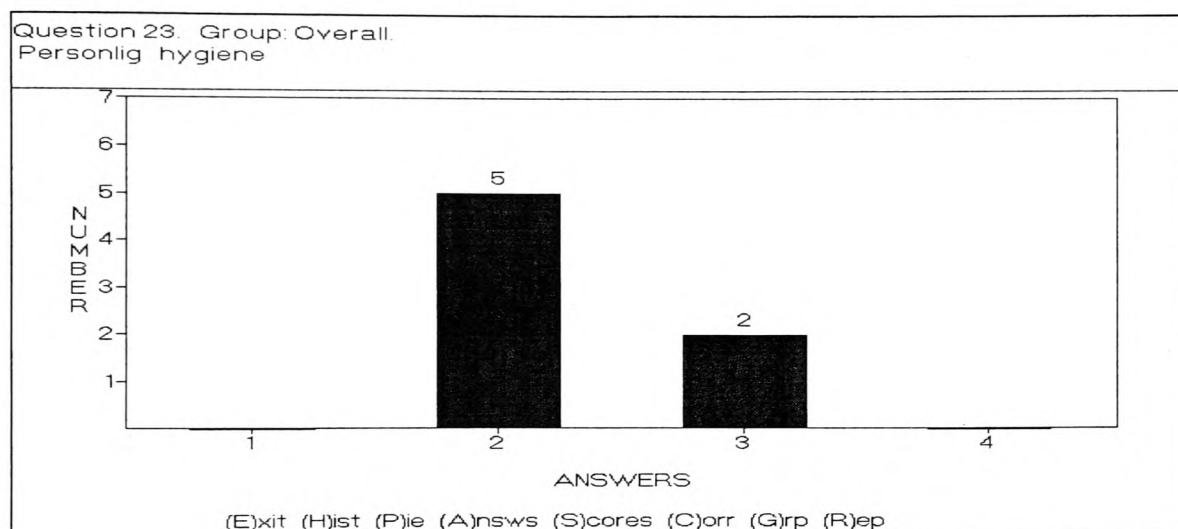


Figure 26: Feedback Bar Chart of Scores for Variable 23

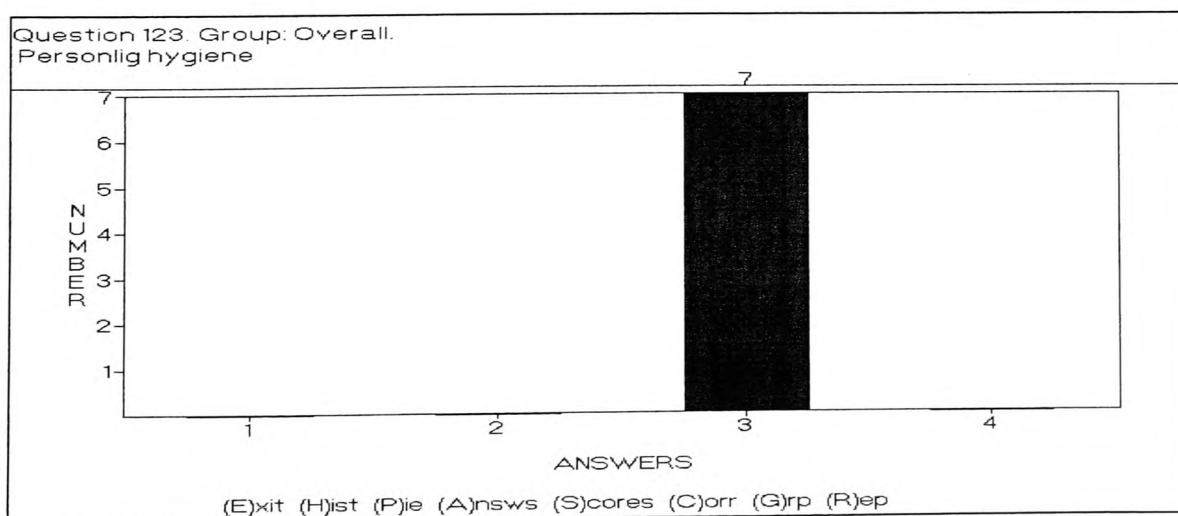


Figure 27: Feedback Bar Chart of Scores after Discussion and Rescoring

23.4 Stage 4 – Panel Evaluation of the Event

The final stage occurred towards the end of each day, and consisted of two statements asking the panel members their opinions on whether the processes employed identified the judgements of each panel member adequately and whether the GSS was easy to use. These statements were:

- 1. I find the procedures and methods highlight the judgements of panel members adequately.*
- 2. I find the system of equipment (handsets and screen) easy to use.*

Allowed responses were:

- 1. Strongly agree*
- 2. Agree*
- 3. Disagree*
- 4. Strongly disagree*

Each panel member then used the Teamworker handset to respond to these two questions, and the summary results were fed back to the group. The responses to these statements were then discussed by the group.

24 Evaluation of the Teamworker GSS In Gerix Initial Trials

These four initial trials concerned the use of the Teamworker GSS with groups of social care professionals concerned with understanding the application of the Gerix framework to enable social care client data to be collected and subsequently utilised. The use of the Teamworker GSS to support professional judgement in these initial trials has been evaluated from the following perspectives:

- a) Evaluation of the group process in terms of the initial group majority and the degree of agreement produced in the panels (process centred evaluation approach).

- b) Evaluation of the type of learning achieved through use of the GSS and associated group process during the initial trials (output centred evaluation approach).
- c) Participant evaluation of the usefulness of the approach for aiding professional judgement (people centred evaluation approach)
- d) Project manager evaluation of the usefulness of the approach for aiding professional judgement (people centred evaluation approach).

These evaluations have also been reported, in part, in Read et al (1999) and Read et al (2003).

24.1 Data Set 1 – Initial Trials

Responses by each group member to the scoring questions posed by the Teamworker GSS for each trial. Each panel contained a mix of different professions such as doctors, nurses, therapists and unqualified carers. In total, 35 clients were assessed by four different panels over four days. The profile of scores obtained for each client across each of the 17 variables naturally differed for each of the clients, but each individual profile demonstrated that there is likely to be some variability of scores obtained from different assessors. To illustrate the degree of variability in scores that occurred during the trial runs, the profile of scores for each of the first clients scored on each day is shown in Table 20. This table shows that, for any client/variable mix, it is likely that there will at least be some disagreement on the score to be applied. On some occasions, this disagreement may be very large. For example, Table 20 shows that, for Client 1 on Variable 32 on Day 2, two panel members scored a “1”, one member scored a “2”, four members scored a “3”, and three members scored a “4”, despite all panel members having at least some knowledge of the client and his/her circumstances.

| Client 1, Day 1, Panel Size = 6 | | | | | Client 1, Day 2, Panel Size = 10 | | | | |
|---------------------------------|------------------------|---|---|----------------------|----------------------------------|------------------------|---|---|----------------------|
| Variable | Completely Independent | | | Completely Dependent | Variable | Completely Independent | | | Completely Dependent |
| | 1 | 2 | 3 | 4 | | 1 | 2 | 3 | 4 |
| 21 | 0 | 3 | 2 | 1 | 21 | 0 | 0 | 8 | 2 |
| 22 | 0 | 3 | 1 | 2 | 22 | 0 | 0 | 0 | 10 |
| 23 | 0 | 2 | 3 | 1 | 23 | 0 | 0 | 2 | 8 |
| 24 | 1 | 2 | 2 | 1 | 24 | 0 | 0 | 0 | 10 |
| 25 | 0 | 3 | 3 | 0 | 25 | 0 | 0 | 0 | 10 |
| 26 | 5 | 1 | 0 | 0 | 26 | 0 | 2 | 8 | 0 |
| 27 | 1 | 2 | 2 | 1 | 27 | 0 | 0 | 0 | 10 |
| 28 | 1 | 3 | 2 | 0 | 28 | 0 | 0 | 0 | 10 |
| 29 | 0 | 0 | 1 | 5 | 29 | 0 | 0 | 0 | 10 |
| 30 | 0 | 1 | 2 | 3 | 30 | 0 | 0 | 0 | 10 |
| 31 | 4 | 1 | 0 | 1 | 31 | 0 | 0 | 8 | 2 |
| 32 | 4 | 2 | 0 | 0 | 32 | 2 | 1 | 4 | 3 |
| 33 | 2 | 4 | 0 | 0 | 33 | 5 | 4 | 1 | 0 |
| 34 | 5 | 1 | 0 | 0 | 34 | 1 | 4 | 5 | 0 |
| 35 | 1 | 4 | 1 | 0 | 35 | 0 | 0 | 2 | 8 |
| 36 | 2 | 4 | 0 | 0 | 36 | 0 | 0 | 3 | 7 |
| 37 | 6 | 0 | 0 | 0 | 37 | 0 | 2 | 8 | 0 |

| Client 1, Day 3, Panel Size = 7 | | | | | Client 1, Day 4, Panel Size = 8 | | | | |
|---------------------------------|------------------------|---|---|----------------------|---------------------------------|------------------------|---|---|----------------------|
| Variable | Completely Independent | | | Completely Dependent | Variable | Completely Independent | | | Completely Dependent |
| | 1 | 2 | 3 | 4 | | 1 | 2 | 3 | 4 |
| 21 | 0 | 7 | 0 | 0 | 21 | 0 | 5 | 3 | 0 |
| 22 | 0 | 0 | 6 | 1 | 22 | 0 | 0 | 5 | 3 |
| 23 | 0 | 5 | 2 | 0 | 23 | 0 | 2 | 6 | 0 |
| 24 | 1 | 5 | 1 | 0 | 24 | 0 | 0 | 8 | 0 |
| 25 | 2 | 5 | 0 | 0 | 25 | 0 | 4 | 4 | 0 |
| 26 | 3 | 4 | 0 | 0 | 26 | 2 | 5 | 1 | 0 |
| 27 | 0 | 0 | 1 | 6 | 27 | 0 | 0 | 7 | 1 |
| 28 | 0 | 1 | 5 | 1 | 28 | 0 | 0 | 8 | 0 |
| 29 | 0 | 0 | 2 | 5 | 29 | 0 | 0 | 5 | 3 |
| 30 | 5 | 1 | 1 | 0 | 30 | 0 | 0 | 8 | 0 |
| 31 | 7 | 0 | 0 | 0 | 31 | 6 | 1 | 1 | 0 |
| 32 | 6 | 1 | 0 | 0 | 32 | 4 | 3 | 1 | 0 |
| 33 | 0 | 5 | 2 | 0 | 33 | 0 | 3 | 5 | 0 |
| 34 | 5 | 2 | 0 | 0 | 34 | 1 | 7 | 0 | 0 |
| 35 | 6 | 1 | 0 | 0 | 35 | 0 | 5 | 3 | 0 |
| 36 | 7 | 0 | 0 | 0 | 36 | 4 | 4 | 0 | 0 |
| 37 | 7 | 0 | 0 | 0 | 37 | 8 | 0 | 0 | 0 |

Table 20: Example Profiles of Clients from Each Panel

The full process as discussed in Section 23 (i.e. score client, view feedback, discuss, re-score, identify reasons for changing scores) was used only for the first two clients for the trial on Day 3 (Oslo, Uranienborg-Majororstuen District, Upper Section) and for the first four clients for the trial on Day 4 (Oslo, Uranienborg-Majororstuen District, Upper Section). Therefore these six clients will comprise the data set used for the evaluation analysis items 1 and 2 above. For clarity, these trial panels will be known as Group 1 (Day 3 panel) and Group 2 (Day 4 panel) and the clients scored using the full process as discussed in Section 23 will be known as Client A, Client B, Client C, Client D, Client E and Client F.

All four trial panels will be considered for the evaluation analysis item (c) above, the participant evaluation of the usefulness of the approach for aiding professional judgement.

24.2 Evaluation of the group process in terms of the range of assessments produced and the effect of the initial group majority

This evaluation is concerned with measuring two aspects of process, as identified in the Input-Process-Outcome Research Framework for GSS Evaluation identified in the Research Methodology chapter, and therefore a process centred approach is used.

The Teamworker GSS is analysed in terms of whether there is convergence of opinion following the “assess, group feedback, discuss, re-assess” protocol adopted, and also whether re-assessments tend to follow the initial dominant view, as identified by the initial modal value (as might be likely if pressure to conform to the dominant view of the group has a significant effect). If the GSS has value in this context we might expect the initial modal value (or dominant initial opinion) to have only a limited effect on the final assessments of the group, and we might also expect a systematic reduction in the range of opinions, as group members engage in dialogue and understand more fully the points of view of other group members.

A typical set of assessments and re-assessments for a client is shown in Table 21. Data of this type has been analysed in order to identify effects of using the GSS on the re-assessments, which we term “final assessments”. It has not been appropriate to

undertake analyses using parametric statistics, as the data has been collected through the use of the 1 to 4 categorical scale, where each scale point represents a different capability of a client with respect to a particular Gerix variable. Non-parametric techniques have therefore been applied (see for example Siegel and Castellan, 1988:35)

| Participant Number: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Mode | Range |
|---------------------|---|---|---|---|---|---|---|---|------|-------|
| Variable 1 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 | 1 |
| Re-assessment | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| Variable 2 | 4 | 4 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 1 |
| Re-assessment | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 |
| Variable 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 |
| Re-assessment | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| Variable 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| Variable 5 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 2,3 | 1 |
| Variable 6 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 2 | 2 | 2 |
| Re-assessment | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 1 |
| Variable 7 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 1 |
| Re-assessment | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| Variable 8 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| Variable 9 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 1 |
| Re-assessment | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 1 |
| Variable 10 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 0 |
| Variable 11 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 2 |
| Re-assessment | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 |
| Variable 12 | 2 | 2 | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 2 |
| Re-assessment | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 |
| Variable 13 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 1 |
| Variable 14 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 1 |
| Re-assessment | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1,2 | 1 |
| Variable 15 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 1 |
| Re-assessment | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 |
| Variable 16 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 2 | 1,2 | 1 |
| Re-assessment | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1,2 | 1 |
| Variable 17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |

Table 21: Assessments and Re-assessments for Group 2/Client C (shaded numbers show where an opinion is changed when reassessed)

Table 22 and Table 23 show summary information for each of the 33 client/variable mixes that were re-assessed in each of the two trials (Group 1 and Group 2). These tables include the number of participants in the group, the number and percentage of participants that changed their assessment as a result of the group process, the original and re-assessed mode, and the original and re-assessed range of assessments.

| Client | Variable | Number of group members | Number changing assessments | Number changing assessments (%) | Original mode | Re-assessed mode | Original Range | Re-assessed Range |
|----------|----------|-------------------------|-----------------------------|---------------------------------|---------------|------------------|----------------|-------------------|
| Client A | 2 | 7 | 1 | 14.3% | 3 | 3 | 1 | 0 |
| | 3 | 7 | 6 | 85.7% | 2 | 3 | 1 | 0 |
| | 4 | 7 | 2 | 28.6% | 2 | 2 | 2 | 0 |
| | 5 | 7 | 2 | 28.6% | 2 | 2 | 1 | 0 |
| | 6 | 7 | 2 | 28.6% | 2 | 2 | 1 | 1 |
| | 7 | 7 | 6 | 85.7% | 4 | 3 | 1 | 0 |
| | 8 | 7 | 2 | 28.6% | 3 | 3 | 2 | 0 |
| | 9 | 7 | 2 | 28.6% | 4 | 4 | 1 | 0 |
| | 10 | 7 | 2 | 28.6% | 1 | 1 | 2 | 0 |
| | 13 | 7 | 2 | 28.6% | 2 | 2 | 1 | 0 |
| | 14 | 7 | 2 | 28.6% | 1 | 1 | 1 | 0 |
| | 3 | 6 | 4 | 66.7% | 2 | 3 | 1 | 0 |
| | 7 | 6 | 2 | 33.3% | 3 | 3 | 2 | 0 |
| | 10 | 6 | 3 | 50.0% | 2 | 2 | 2 | 0 |

Table 22: Summary Information for Group 1

| Client | Variable | Number of group members | Number changing assessments | Number changing assessments (%) | Original mode | Re-assessed mode | Original Range | Re-assessed Range |
|----------|----------|-------------------------|-----------------------------|---------------------------------|---------------|------------------|----------------|-------------------|
| Client C | 1 | 8 | 5 | 62.5% | 2 | 3 | 1 | 0 |
| | 2 | 8 | 2 | 25.0% | 3 | 3 | 1 | 1 |
| | 3 | 8 | 2 | 25.0% | 3 | 3 | 1 | 0 |
| | 6 | 8 | 6 | 75.0% | 2 | 3 | 2 | 1 |
| | 7 | 8 | 1 | 12.5% | 3 | 3 | 1 | 0 |
| | 11 | 8 | 1 | 12.5% | 1 | 1 | 2 | 1 |
| | 12 | 8 | 2 | 25.0% | 1 | 2 | 2 | 1 |
| | 14 | 8 | 3 | 37.5% | 2 | 1,2 | 1 | 1 |
| | 15 | 8 | 3 | 37.5% | 2 | 2 | 1 | 0 |
| | 16 | 8 | 2 | 25.0% | 1,2 | 1,2 | 1 | 1 |
| | 3 | 8 | 4 | 50.0% | 2,3 | 3 | 1 | 0 |
| Client D | 6 | 8 | 7 | 87.5% | 1,2 | 2 | 2 | 1 |
| | 8 | 8 | 2 | 25.0% | 3 | 3 | 2 | 0 |
| | 9 | 8 | 3 | 37.5% | 3 | 3 | 2 | 0 |
| | 12 | 8 | 4 | 50.0% | 1 | 2 | 2 | 2 |
| | 16 | 8 | 3 | 37.5% | 2 | 2 | 2 | 0 |
| | 1 | 8 | 6 | 75.0% | 2 | 2,3 | 2 | 1 |
| Client E | 1 | 8 | 2 | 25.0% | 4 | 4 | 2 | 0 |
| Client F | 5 | 8 | 6 | 75.0% | 4 | 3 | 2 | 0 |

Table 23: Summary Information for Group 2

24.2.1 Analysis of the Changes to the Range of Assessments

Overall, 85% of re-assessments led to a change in the range of assessments, and all of these changes resulted in a reduction of the range. The remaining 15% of re-assessments led to no change in the range following re-assessment, and there were no instances of the range of assessments increasing following re-assessment. A null hypothesis is presented below, on the basis of assuming that it is equally likely for the range increasing or reducing for final assessments compared with initial assessments.

Null Hypothesis 1. There are equal probabilities of the range of final assessments reducing or increasing when compared with the range of initial assessments.

For each of the 28 range changes, there were no instances of the range increasing; the range of assessments decreased in every case. Using the chi-squared test at the 5% level of significance, the null hypothesis is rejected; the range of assessments is likely to reduce on re-assessment. There does appear to be a systematic effect through using the GSS that results in a reduction in the range of assessments, indicating that there will be a greater degree of agreement among the participants as a result of the feedback of initial assessments and the ensuing dialogue.

24.2.2 Analysis of the Effect of the Initial Mode on Final Assessments

It might be expected that final assessments, following feedback of initial assessment and discussion, would tend to follow the initial dominant opinion, based on the mode, due to a tendency to conform. It follows from Table 22 and Table 23 that out of the 33 client/variable mixes that were re-assessed, the mode changed, or partially changed, on 12 occasions (or on 36% of occasions). This analysis considers the extent to which the original dominant view was followed by individual assessors when a client/variable mix is re-assessed.

In the first group, there were a total of 221 initial assessments (where 7 group members assessed the first client and 6 group members assessed the second client on each of the 17 Gerix criteria) and a total of 95 individual opportunities for re-assessment (i.e. 11 variables were re-assessed for the first client, and 3 variables were re-assessed for the

second client). Of the 95 individual opportunities for re-assessment, 37 resulted in a change of assessment. For the second group, there were a total of 544 initial assessments (8 group members assessing all 4 clients on each of the 17 Gerix criteria) and a total of 152 individual opportunities for re-assessments (i.e. a total of 19 variables were re-assessed across all 4 clients). Of the 152 individual opportunities for re-assessment, 60 resulted in a change of assessment. The extent to which the 37 assessment changes for the first group, and the 60 assessment changes for the second group, followed the original modal value is shown in Table 24 and Table 25.

| Participant No | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | Total | | Total % | |
|----------------|----|----|----|----|----|----|----|----|-----|----|----|----|----|----|-------|----|---------|----|
| | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F |
| Client A | 2 | 1 | 0 | 2 | 2 | 2 | 3 | 2 | 4 | 0 | 4 | 2 | 2 | 2 | 17 | 11 | 61 | 39 |
| Client B | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | NA | NA | 0 | 0 | 1 | 0 | 5 | 4 | 56 | 44 |
| Total | 4 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 4 | 0 | 4 | 2 | 3 | 2 | 22 | 15 | 59 | 41 |
| Total % | 67 | 33 | 25 | 75 | 50 | 50 | 50 | 50 | 100 | 0 | 67 | 33 | 60 | 40 | 59 | 41 | | |

Table 24: Comparison of final assessments with initial modal values for Group 1 (C = Final assessment closer to initial mode, F = Final assessment further from initial mode)

| Participant No | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | Total | | Total % | |
|----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|----|---------|----|
| | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F | C | F |
| Client C | 3 | 1 | 2 | 1 | 0 | 2 | 1 | 1 | 0 | 2 | 3 | 0 | 2 | 2 | 0 | 4 | 11 | 13 | 46 | 54 |
| Client D | 1 | 1 | 1 | 0 | 3 | 2 | 0 | 1 | 4 | 1 | 2 | 0 | 3 | 2 | 0 | 0 | 14 | 7 | 67 | 33 |
| Client E | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 3 | 4 | 43 | 57 |
| Client F | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 3 | 5 | 38 | 62 |
| Total | 6 | 3 | 3 | 2 | 3 | 6 | 1 | 3 | 5 | 4 | 6 | 1 | 6 | 5 | 1 | 5 | 31 | 29 | 52 | 48 |
| Total % | 67 | 33 | 60 | 40 | 33 | 67 | 25 | 75 | 56 | 44 | 86 | 14 | 58 | 42 | 14 | 86 | 52 | 48 | | |

Table 25: Comparison of final assessments with initial modal values for Group 2 (C = Final assessment closer to initial mode, F = Final assessment further from initial mode)

In the first group, 59% of the final assessments were closer to the initial mode and 41% were further from the initial mode. In the second group, 52% of final assessments were closer to the initial mode and 48% of re-assessments were further from the initial mode. If the initial modal value has limited effect on the final assessments, we assume that the probabilities of the final assessment being closer to the initial modal value, or further from the initial modal value, to be equal.

Null Hypothesis 2. The probability that an individual's final assessment is closer to the initial mode is equal to the probability that an individual's final assessment is further from the initial mode.

Using the chi squared test at the 5% level of significance, this null hypothesis cannot be rejected for either group; there does not appear to be an identifiable tendency to follow the dominant viewpoint.

24.3 Evaluation of the type of learning achieved through use of the GSS and associated group process during the initial trials

The type of learning achieved is an outcome measure, as identified in the evaluation research framework in the Methodology chapter (Appendix 3), as is measured using an output evaluation approach.

As a significant degree of 'opinion changing' was observed on Day 1 and Day 2 of these trials, it was decided to give participants the opportunity to record their reason(s) for a change on Days 3 and 4 (i.e. Group 1 and Group 2).

This was achieved by asking an extra question after each re-scoring as follows:

Please give your reason(s) on the 1-9 scale for changing your input on this variable where:

| | | | | | | | | |
|--|---|---|------------------------------|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| ↑ | | | | ↑ | | | | ↑ |
| Additional knowledge (related to given client) | | | Both reasons (about equally) | | | Improved understanding (of GERIX model) | | |

The anchor points 1, 5 and 9 were defined as shown and members could respond from 1 to 9 in accordance with their judgement as to the reason(s) for their change of opinion on the immediately preceding input. The groups decided when they wished to re-score, and when they wished to ask this question of themselves.

Table 26 and Table 27 shows the outputs from this additional question after scoring had occurred for each of the panels on Day 3 and Day 4. For example, for client 1 on variable 23 on Day 3, one member changed his mind because he had obtained additional information related to a client, and four members changed their minds because they had additional understanding of the Gerix variable.

From these two tables, it can be seen that in most cases, members scored either a "1" or a "9", demonstrating that the members were very clear as to the reason why they had changed their minds, and this reason was either that they had additional information on the client or that they had improved understanding on the Gerix variable under consideration. In response to this question, 54% of panel members changed their mind due to improved understanding of the Gerix variables, 32% changed their mind due to additional information on a client, and 14% had a mixture of reasons.

| Variable | Client A | | | Client B | | |
|----------|--|---------------|---|--|---------------|---|
| | Additional information related to client | Mixed reasons | Additional understanding related to variable in Gerix | Additional information related to client | Mixed reasons | Additional understanding related to variable in Gerix |
| | 1 | 2 - 8 | 9 | 1 | 2 - 8 | 9 |
| 21 | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - |
| 23 | 1 | 0 | 4 | - | - | - |
| 24 | 1 | 1 | 0 | 0 | 0 | 4 |
| 25 | 0 | 1 | 1 | - | - | - |
| 26 | 0 | 1 | 1 | - | - | - |
| 27 | 0 | 0 | 6 | 1 | 0 | 1 |
| 28 | 1 | 0 | 1 | - | - | - |
| 29 | 0 | 0 | 2 | - | - | - |
| 30 | 1 | 1 | 0 | 1 | 0 | 2 |
| 31 | - | - | - | - | - | - |
| 32 | - | - | - | - | - | - |
| 33 | 0 | 1 | 1 | - | - | - |
| 34 | 0 | 0 | 2 | - | - | - |
| 35 | - | - | - | - | - | - |
| 36 | - | - | - | - | - | - |
| 37 | - | - | - | - | - | - |
| Totals | 4 | 5 | 18 | 2 | 0 | 7 |

Table 26: Reasons for Change of Judgement for Group 1 (Day 3 Panel)

| Variable | Client C | | | Client D | | |
|----------|--|---------------|---|--|---------------|---|
| | Additional information related to client | Mixed reasons | Additional understanding related to variable in GERIX | Additional information related to client | Mixed reasons | Additional understanding related to variable in GERIX |
| | 1 | 2 - 8 | 9 | 1 | 2 - 8 | 9 |
| 21 | 1 | 0 | 4 | - | - | - |
| 22 | 0 | 0 | 2 | - | - | - |
| 23 | 0 | 0 | 2 | 2 | 0 | 2 |
| 24 | - | - | - | - | - | - |
| 25 | - | - | - | - | - | - |
| 26 | 1 | 1 | 3 | 3 | 0 | 4 |
| 27 | 1 | 0 | 0 | - | - | - |
| 28 | - | - | - | 1 | 0 | 0 |
| 29 | 0 | 0 | 0 | 3 | 0 | 0 |
| 30 | - | - | - | - | - | - |
| 31 | 0 | 0 | 0 | - | - | - |
| 32 | 0 | 2 | 0 | 3 | 1 | 0 |
| 33 | - | - | - | - | - | - |
| 34 | 1 | 0 | 2 | - | - | - |
| 35 | 1 | 0 | 2 | - | - | - |
| 36 | 0 | 0 | 1 | - | - | - |
| 37 | - | - | - | - | - | - |
| Totals | 5 | 3 | 16 | 12 | 1 | 6 |

| Variable | Client E | | | Client F | | |
|----------|--|---------------|---|--|---------------|---|
| | Additional information related to client | Mixed reasons | Additional understanding related to variable in GERIX | Additional information related to client | Mixed reasons | Additional understanding related to variable in GERIX |
| | 1 | 2 - 8 | 9 | 1 | 2 - 8 | 9 |
| 21 | 2 | 1 | 3 | 1 | 1 | 1 |
| 22 | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - |
| 25 | - | - | - | 4 | 2 | 0 |
| 26 | - | - | - | - | - | - |
| 27 | - | - | - | - | - | - |
| 28 | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - |
| 31 | - | - | - | - | - | - |
| 32 | - | - | - | - | - | - |
| 33 | - | - | - | - | - | - |
| 34 | - | - | - | - | - | - |
| 35 | - | - | - | - | - | - |
| 36 | - | - | - | - | - | - |
| 37 | - | - | - | - | - | - |
| Totals | 2 | 1 | 3 | 5 | 3 | 1 |

Table 27: Reasons for Change of Judgement for Group 2 (Day 4 Panel)

This analysis demonstrates that a key reason for re-scoring is connected with improved understanding of the model and its variables. While the data is limited in amount, it does appear that the frequency of changes related to client knowledge (1) is variable, while the number of changes due to variable definition (9) tends to fall for members as they move from one client to the next on the agenda. The data supports a proposition that rapid learning of the variables of the Gerix model is taking place, especially in terms of how to place clients on the 1-4 scale for each of the 17 variables in a consistent manner.

24.4 Participant Evaluation of the Trial Sessions

The Project Manager was particularly keen to identify whether the participants felt that their individual judgements were adequately identified, and whether the Teamworker GSS was easy (or not) to use. This evaluation is therefore an outcome measure, and is measured using a people-centred evaluation approach, in that the participants were directly asked these questions, and asked to respond using the Teamworker handsets.

Therefore, at the end of each of the four trials, two additional questions were asked in order to evaluate the value of the GSS used at the meetings. The first question was concerned with whether the procedures and methods used during the meeting (including, for example, choice of clients, role of panel leader, use of handsets etc.) capture the judgements of the panel members adequately. The second question was concerned with whether the panel members found the system of Teamworker handsets and large screen feedback easy to use.

Table 28 gives the results to these and shows that the responses to these questions are very positive. Out of a total of 29 respondents still remaining at the end of the trials, only one person disagreed that the procedures and methods highlighted the judgements of the panel members adequately, and all agreed that the system of equipment was easy to use. The responses were displayed back to the panels in histogram form for further discussion. Most agreed that the meetings had been very productive and beneficial in helping the panel members further understand the interpretation and application of the Gerix criteria in a consistent manner.

| | I find the procedures and methods highlight the judgements of panel members adequately | | | | I find the system of equipment (handsets and screen) easy to use | | | |
|-----------|--|-------|----------|-------------------|--|-------|----------|-------------------|
| Day | Strongly Agree | Agree | Disagree | Strongly Disagree | Strongly Agree | Agree | Disagree | Strongly Disagree |
| 1 | 4 | 2 | 0 | 0 | 6 | 0 | 0 | 0 |
| 2 | 3 | 6 | 0 | 0 | 7 | 2 | 0 | 0 |
| 3 | 6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 |
| 4 | 0 | 7 | 1 | 0 | 7 | 1 | 0 | 0 |
| Total | 13 | 15 | 1 | 0 | 26 | 3 | 0 | 0 |
| Total (%) | 45% | 52% | 3% | 0% | 90% | 10% | 0% | 0% |

Table 28: Participant Responses for System Evaluation Questions

The questions at this final stage were limited to two as it was recognised that the panel members had been involved in a detailed and tiring process throughout the day.

However the responses to these questions and the resulting discussions are encouraging in terms of the evaluating of the Teamworker GSS in this context, at least from the perspective of the Gerix Project manager.

24.5 Project Manager Evaluation of the Trial Sessions

A major stakeholder in the initial trials is the Gerix Project Manager, Rune Devold, who was responsible for determining the method of training that would need to be used to develop professional judgement in the application of the Gerix framework. He was therefore asked to identify the advantages and disadvantages of using the GSS in this and other contexts. This is an outcome measure, as identified in the Input-Process-Outcome research evaluation framework identified in the Methodology chapter and is measured using a people centred evaluation approach. It should be noted that Rune Devold has also co-authored two articles with myself and Dr Gear (Read *et al*, 1998; Read *et al*, 2003).

These trials were the first time that the project manager had seen a GSS in action with a group, and on the basis of these trials he identified the following advantages of using Teamworker.

24.5.1 Gerix Specific Perceived Advantages (As Identified by Gerix Project Manager)

1. The structure enforced by the system gave the Gerix project management team the opportunity to present and have assessed the same issues by many professionals in a standardised way.
2. Every person in the group is equal and it is more difficult to dominate the group. In particular, in panel discussions where the panels contain a mix of professions, 'higher status' professionals (e.g. doctors, nurses, physiotherapists) will often dominate the proceedings and 'lower status' professionals (e.g. assistant nurses and home-helpers) will often defer to their higher status colleagues. The anonymity provided by the GSS meant that the lower status professionals (who may have better information) could give their opinion without being influenced by the higher status members.
3. It is possible to run group sessions repetitively and monitor trends over time. This can help identify whether assessments are becoming more standardised as care workers are trained and obtain greater experience of applying the Gerix variables.
4. The use of the system enabled weaknesses in the definition of the Gerix variables to be identified.
5. The Project Manager believed that the trials had been extremely successful, and demonstrated the benefit of using such a system in a training context to support a group of people understand the nature and implementation of a model which must be consistently applied to enable the information generated to be meaningful.

24.5.2 Generic Meeting Perceived Advantages (As Identified by Gerix Project Manager)

1. Managers are forced to set up a structure for a meeting and consider the objectives of the meeting, rather than run meetings on an ad-hoc basis.

2. Everybody is made to take part in the group process and actually make decisions - helping individuals to develop as decision makers.
3. The system gives an ideal platform for discussions through surveying the different opinions within the group and displaying these differences back to the group. The resulting histogram shows differences of opinions in an anonymous and non threatening format, which can be vital to ensure the full range of opinions in a group are collected and considered. Solutions to problems that some may feel should be “taken for granted” can be tested by all of the group.
4. Data can be saved for statistical use/calculation and control of acceptability of statistical margins. The saved data can also be useful if the rationale for a particular decision needs to be made to a wider audience.
5. The project manager believed that such a system could be regularly used by management groups in the public sector, and could help limit the arbitrary nature of some decisions, especially those of a strategic nature.

24.5.3 Perceived Disadvantages of the GSS

The Gerix Project Manager also recognised some disadvantages of adopting a GSS to support the group process. These were:

1. The cost of the system is likely to mean that it will only be used in a limited number of situations where the increased cost can be justified on efficiency grounds. This is one reason why the project manager does not believe that the system would be adopted for everyday case conferences by the Norwegian municipalities.
2. Not everybody would appreciate the introduction of the system into decision-making meetings as it might reduce the flexibility of the meeting and also affect the power that can be wielded by some individuals.
3. Technical equipment is required which must be brought to the meeting room and set up before the meeting begins. There is also the risk that the system will malfunction in some way, which could prove disastrous to the meeting.

4. Although the system is easy to use, it does require someone to be trained to set the system up and operate the software.

25 Subsequent Adoption of the Teamworker GSS for Gerix Training

The data collected at these initial trials were independently analysed by Statistics Norway (the Norwegian Government Statistical Service) to support the decision on whether or not to use the Teamworker GSS for Gerix training in the future. Following the trials, TeamStandards AS decided to adopt the Teamworker GSS as a standard tool for training in the Gerix framework in all municipalities. The Teamworker software was slightly modified (by myself) to ensure that output files were produced to TeamStandards AS specification. Also, a number of Gerix trainers were trained in the use of the Teamworker GSS.

The way that the Gerix training was organised was to use one or more 'standard' client cases, where the Gerix profile could be determined 'by experts' in advance. This case is introduced to the members of a training group through a video showing the standard client being interviewed by a nurse. The training groups are then asked to assess the standard client using the Gerix framework, supported by the Teamworker GSS using a similar process to that described in the initial trials. The additional evaluation that can be undertaken here is that of whether the group process involving the Teamworker GSS can help individual participants move closer to the 'correct' scores, as previously identified by the 'experts'. It should be noted also that the original 17 Gerix variables as defined in Section 22 had been slightly modified following the initial trial sessions.

Additionally, a new Project Manager employed by TeamStandards, Per Meland, was placed in charge of this training programme.

25.1 The Standardised Gerix Training Procedure

A standardised group training process was developed by TeamStandards AS, to be used by all personnel requiring training in the Gerix methodology. All personnel required to learn how to apply the Gerix framework have to go through two of these group training

sessions. The objective of the Gerix training sessions is to improve the understanding of trainees in the application of the Gerix framework

The training sessions involve groups of trainees supported by the Teamworker GSS. Each group includes a chairperson who was involved in the writing of the Gerix Manual, and is therefore perceived to be a Gerix 'expert'. The group size is typically between 12 and 24 participants.

The training process developed by TeamStandards for Gerix training is as follows:

1. Each training session lasts a full day (8 hours). The first 2 hours is concerned with understanding the Gerix manual.
2. The participants are then shown how the Teamworker GSS works through a simple general knowledge question.
3. After this initial training, two videos are shown and the participants are asked to score each of the Gerix variables for the situations described in each of the two videos.
4. Each video and scoring session lasts around 3 hours (6 hours for the two videos).
5. For each video session, there is first a brief introduction to the video, including an explanation of what the video is intended to show, and what to listen and look for
6. Following the video, each Gerix variable is displayed on the large screen and scored using the Teamworker handsets.
7. After each variable is scored, the distribution of scores is displayed back to the group using a bar chart and discussed.
8. After all variables have been scored and discussed, each variable is then re-scored.
9. The re-scored bar charts are shown to the participants one by one, and it is noted how the distribution of scores have moved from the first score. The chairperson then asks why participants may have changed their score (i.e. had more information been obtained in the discussion on the client or on the application of the Gerix criteria).
10. The correct score, as determined by the 'expert' is then revealed and discussed.

11. At the end of the session, an evaluation question on the session is asked, concerned with whether the participants felt that the objectives of the session were met through using the Teamworker GSS.

25.2 Data Set 2 – Gerix Training Sessions

Seven individual sessions with one of the videos are available for further analysis (provided by TeamStandards AS). These sessions involve groups from the Norwegian municipalities identified in Table 29.

| Municipality | Group Size | Population |
|----------------------|------------|------------|
| Arendal | 24 | 38,300 |
| Borre | 24 | 22,800 |
| Eidsvoll | 24 | 16,900 |
| Kvam | 24 | 8,600 |
| Lillehammer | 24 | 23,600 |
| Ringerike | 12 | 27,400 |
| Svest (Oslo Central) | 18 | 80,200 |

Table 29: Municipality Information for Analysed Gerix Training Sessions

The video analysed in each of these sessions is known as ‘Video 3’. This video shows a lady aged 90, living on her own in a flat in Oslo. She is interviewed by a nurse, and during the interview it should be possible to identify all the relevant information to be able to score each of the Gerix variables.

26 Evaluation of the Gerix Training Sessions

The data from these seven training sessions has enabled the evaluation of the degree to which individual participants move closer to the known ‘correct’ scores; if the process using Teamworker GSS has value, it would be expected that individuals will get closer to the ‘correct’ scores following re-scoring.

The participants in six of the seven Gerix training sessions were also asked a single evaluation question, concerned with whether the participants felt that the objectives of the training session were met. This enables some analysis of the satisfaction of the participants to be undertaken. Additionally, the project manager for this training programme, Per Meland, has been asked to identify his views on the usefulness, or not, of using the Teamworker GSS in this context.

Also, the Association of Municipalities in Denmark (Kommunernes Landsforening) has recently adopted a similar framework to Gerix for elderly care client evaluation (known as Faelles Sprog, or 'Common Language') and, on the basis of the Gerix training undertaken in Norway, has adopted a similar group training method, using the Teamworker GSS. Participant evaluations from 17 group sessions have been made available, and these are also presented here.

The adoption and use of the Teamworker GSS for Gerix training following the initial trials discussed in Section 23 therefore enables the evaluation of the Teamworker GSS from the following perspectives:

- a) Evaluation of the degree to which individual participants move closer to the known 'correct' scores (output evaluation approach).
- b) Evaluation of the perceived usefulness of the Teamworker GSS in meeting the objectives of the training sessions – the improvement of professional knowledge in terms of the application of the Gerix framework (people centred evaluation approach).

26.1 Evaluation of the degree to which individual participants move closer to the known 'correct' scores

As the objective of the Gerix training session is to improve the understanding of trainees in the application of the Gerix framework, then if the procedure utilising Teamworker has value, it would be expected that individuals get closer to the correct scores following re-scoring. This is an outcome measure, as defined in the Input-Process-Outcome research framework identified in the Methodology chapter and an outcome evaluation approach is used to compare first scores and re-scores with the correct score, as defined on Video 3.

Table 30 displays a table that shows all of the re-score possibilities for each of the participants and 17 Gerix variables for each of the seven different sessions (in terms of both numbers and percentages). For example, for the first session (Arend) there were a total of 24 multiplied by 17 re-scores (the number of participants multiplied by the number of Gerix variables). Therefore a total of 408 re-score opportunities are available

in the Arend session. Each re-score could result in any one of the following eight possibilities:

1. No change in re-score and correct
2. No change in re-score and incorrect
3. A movement from incorrect to correct following re-score
4. An improvement in the re-score, but still incorrect
5. A movement from correct to incorrect following re-score
6. A deterioration from an incorrect score following the re-score
7. The re-score is different from the original score, but the distance from the correct score is the same
8. Either the first or second score was invalid (i.e. a no score)

| Sessions | Arend | Borre | Eidsv | Kvam | Lilleh | Ring | Svest | Total |
|---------------------------------|-------|-------|-------|-------|--------|-------|-------|-------|
| No Change and correct | 304 | 268 | 258 | 276 | 285 | 138 | 194 | 1723 |
| No Change and incorrect | 48 | 30 | 62 | 35 | 61 | 17 | 27 | 280 |
| Incorrect to correct | 44 | 90 | 24 | 62 | 26 | 36 | 65 | 347 |
| Improvement but still incorrect | 2 | 7 | 5 | 8 | 1 | 0 | 3 | 26 |
| Correct to incorrect | 6 | 13 | 8 | 17 | 18 | 12 | 15 | 89 |
| Incorrect then worse | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |
| Change but same difference | 2 | 0 | 0 | 9 | 1 | 1 | 2 | 15 |
| First or second score invalid | 1 | 0 | 51 | 0 | 16 | 0 | 0 | 68 |
| | 408 | 408 | 408 | 408 | 408 | 204 | 306 | 2550 |
| | | | | | | | | |
| Percentages | Arend | Borre | Eidsv | Kvam | Lilleh | Ring | Svest | Total |
| No Change and correct | 74.5 | 65.7 | 63.2 | 67.6 | 69.9 | 67.6 | 63.4 | 67.6 |
| No Change and incorrect | 11.8 | 7.4 | 15.2 | 8.6 | 15.0 | 8.3 | 8.8 | 11.0 |
| Incorrect to correct | 10.8 | 22.1 | 5.9 | 15.2 | 6.4 | 17.6 | 21.2 | 13.6 |
| Improvement but still incorrect | 0.5 | 1.7 | 1.2 | 2.0 | 0.2 | 0.0 | 1.0 | 1.0 |
| Correct to incorrect | 1.5 | 3.2 | 2.0 | 4.2 | 4.4 | 5.9 | 4.9 | 3.5 |
| Incorrect then worse | 0.2 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.1 |
| Change but same difference | 0.5 | 0.0 | 0.0 | 2.2 | 0.2 | 0.5 | 0.7 | 0.6 |
| First or second score invalid | 0.2 | 0.0 | 12.5 | 0.0 | 3.9 | 0.0 | 0.0 | 2.7 |
| | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 30: Summary Analyses for Video 3 Gerix Training Sessions (Across Sessions)

| Variables | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | Total |
|---------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| No Change and correct | 138 | 98 | 136 | 108 | 83 | 142 | 131 | 32 | 85 | 94 | 144 | 136 | 81 | 30 | 38 | 119 | 128 | 1723 |
| No Change and incorrect | 0 | 5 | 0 | 12 | 34 | 0 | 0 | 57 | 26 | 12 | 0 | 2 | 4 | 59 | 61 | 5 | 3 | 280 |
| Incorrect to correct | 7 | 40 | 9 | 19 | 21 | 3 | 13 | 36 | 34 | 39 | 2 | 5 | 58 | 11 | 20 | 18 | 12 | 347 |
| Improvement but still incorrect | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 19 | 0 | 2 | 1 | 26 |
| Correct to incorrect | 0 | 2 | 1 | 7 | 7 | 1 | 2 | 11 | 1 | 0 | 0 | 2 | 2 | 28 | 22 | 1 | 2 | 89 |
| Incorrect then worse | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2 |
| Change but same difference | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 15 |
| 1st or second score invalid | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 5 | 4 | 4 | 68 |
| Total | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 2550 |
| Percentage | | | | | | | | | | | | | | | | | | |
| No Change and correct | 92.0 | 65.3 | 90.7 | 72.0 | 55.3 | 94.7 | 87.3 | 21.3 | 56.7 | 62.7 | 96.0 | 90.7 | 54.0 | 20.0 | 25.3 | 79.3 | 85.3 | 67.6 |
| No Change and incorrect | 0.0 | 3.3 | 0.0 | 8.0 | 22.7 | 0.0 | 0.0 | 38.0 | 17.3 | 8.0 | 0.0 | 1.3 | 2.7 | 39.3 | 40.7 | 3.3 | 2.0 | 11.0 |
| Incorrect to correct | 4.7 | 26.7 | 6.0 | 12.7 | 14.0 | 2.0 | 8.7 | 24.0 | 22.7 | 26.0 | 1.3 | 3.3 | 38.7 | 7.3 | 13.3 | 12.0 | 8.0 | 13.6 |
| Improvement but still incorrect | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.7 | 0.7 | 12.7 | 0.0 | 1.3 | 0.7 | 1.0 |
| Correct to incorrect | 0.0 | 1.3 | 0.7 | 4.7 | 4.7 | 0.7 | 1.3 | 7.3 | 0.7 | 0.0 | 0.0 | 1.3 | 1.3 | 18.7 | 14.7 | 0.7 | 1.3 | 3.5 |
| Incorrect then worse | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.7 | 0.0 | 0.1 |
| Change but same difference | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.7 | 0.0 | 0.0 | 0.6 |
| 1st or second score invalid | 3.3 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.0 | 2.0 | 3.3 | 2.7 | 2.7 | 2.7 |
| | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 31: Summary Analyses for Video 3 Gerix Training Sessions (Across Questions)

Table 31 shows the same information, but this time summarised across question numbers.

The issue that is investigated here is when an initial score is incorrect, is the re-score more likely to be a correct score rather than an incorrect score? A related issue is whether a correct initial score becomes an incorrect score following re-scoring. Table 32 shows summary data across all sessions for all possible outcomes following re-score other than the first possible outcome (i.e. a correct first score by an individual participant and no change of score in the re-score) and the last possible outcome (first or second score invalid).

| Possible Re-score Consequence | Number | Percentage |
|---------------------------------|--------|------------|
| No Change and incorrect | 280 | 36.9 |
| Incorrect to correct | 347 | 45.7 |
| Improvement but still incorrect | 26 | 3.4 |
| Correct to incorrect | 89 | 11.7 |
| Incorrect then worse | 2 | 0.3 |
| Change but same difference | 15 | 2.0 |
| TOTAL | 759 | 100.0 |

Table 32: Summary Data (not including situations where both initial score and re-score for an individual participant are correct)

Over 45% of re-scores demonstrated a movement from an incorrect initial score to the correct score. 37% of scores were unchanged from the initial score but were still incorrect, and, interestingly, almost 12% of re-scores moved from an initial score that was correct to an incorrect score.

This was investigated further using Table 31. From this table it can be seen that variables 28, 34 and 35 all seem to give greater a greater number of incorrect initial scores than correct scores, and a large proportion of the re-scores do not change and remain incorrect. These questions are summarised in Table 33.

| Variables | 28 | 34 | 35 |
|---------------------------------|-----------|-----------|-----------|
| No Change and correct | 32 | 30 | 38 |
| No Change and incorrect | 57 | 59 | 61 |
| Incorrect to correct | 36 | 11 | 20 |
| Improvement but still incorrect | 0 | 19 | 0 |
| Correct to incorrect | 11 | 28 | 22 |
| Incorrect then worse | 0 | 0 | 0 |
| Change but same difference | 10 | 0 | 4 |
| 1st or second score invalid | 4 | 3 | 5 |
| Total | 150 | 150 | 150 |

Table 33: Analysis of Variables 28, 34, 35

The Gerix Training Manager recognised a problem with these specific variables (28 - food preparation, 34 – feeling of security and 35 - ability to socialise) in that the manual was more ambiguous in terms of what a score of 1 to 4 meant for these specific variables. It was therefore recognised that the manual required updating for these specific variables.

Table 34 shows the same summary table as shown in Table 32 but this time with variables 28, 34 and 35 withdrawn.

| Possible Re-score Consequence | Number | Percentage |
|--------------------------------------|---------------|-------------------|
| No Change and incorrect | 103 | 24.5 |
| Incorrect to correct | 280 | 66.5 |
| Improvement but still incorrect | 7 | 1.6 |
| Correct to incorrect | 28 | 6.7 |
| Incorrect then worse | 2 | 0.5 |
| Change but same difference | 1 | 0.2 |
| TOTAL | 421 | 100.0 |

Table 34: Summary Data (not including initial score and re-score correct)

Taking out the ambiguous questions 28, 34 and 35 results in 66.5% of scores moving from an initial incorrect score to a re-scored correct score.

26.2 Participant Evaluation of Gerix Training Sessions

A single evaluation question was asked of the participants at the end of the training session for six of the seven training sessions. This question asked those participants remaining to rate their satisfaction on the achievement of the training session objectives (i.e. development of professional knowledge in relation to the application of the Gerix framework) using a 1 to 4 scale, where:

- 1 – Very dissatisfied
- 2 – Dissatisfied
- 3 – Satisfied
- 4 – Very satisfied

The responses from the participants in each of the six sessions are shown in Table 35.

| Training Session | Evaluation Score | | | |
|------------------|------------------|----|-----|-----|
| | 1 | 2 | 3 | 4 |
| Arendal | 0 | 0 | 12 | 12 |
| Borre | 0 | 0 | 10 | 14 |
| Eidsvoll | 0 | 0 | 10 | 11 |
| Kvam | 0 | 0 | 6 | 16 |
| Lillehammer | 0 | 0 | 11 | 12 |
| Ringerike | 0 | 0 | 1 | 11 |
| Total | 0 | 0 | 50 | 76 |
| Total (%) | 0% | 0% | 40% | 60% |

Table 35: Evaluation of the Training Sessions by Participants

Table 35 shows that all participants were satisfied that the objectives had been achieved, and that 60% of participants overall were very satisfied.

26.3 Project Manager Evaluation of Gerix Training Sessions

Following the initial trials the Gerix Project Manager, Rune Devold, was asked his opinions of the advantages and disadvantages of using the Teamworker GSS in this training context (see Section 24.5). The Gerix training programme project manager (Per Meland) was also subsequently asked to identify his views on the advantages and disadvantages of using the Teamworker GSS in this context. In terms of the Input-

Process-Outcome research evaluation framework identified in the Methodology chapter, this is an outcome measure and is measured through a people centred evaluation approach.

The Gerix training programme manager identified the following benefits of using the Teamworker GSS in this context:

- a) He felt that a very fast 'learning result' could be obtained through using the system. This was in part due to the intensity of concentration of the session participants that was supported by the system. All participants had to respond to the questions using the handsets, therefore all participants needed to concentrate on the task throughout the session.
- b) He also felt that less time to achieve the desired level of learning was required through using the system compared to conventional training. He considered it easier to generate discussion to support the learning objectives, and that motivation throughout the session was higher than a more conventional training session.
- c) The Gerix training programme project manager could not identify any disadvantages to using the system in this context (this is in contrast to the Gerix Project Manager, who identified considerations of cost, technical aspects, flexibility and aspects of power influence as possible issues when introducing a system such as the Teamworker GSS – see Section 24.5.3).
- d) The Gerix training programme project manager also felt that the Teamworker GSS would be useful in other training contexts, and identified medical diagnosis and the training of control room operators as possible training application areas.

It should also be commented at this point that Gerix training is still undertaken with the support of the Teamworker GSS, and that this training process has now been used for over five years. Therefore similar arguments regarding the continued use of a system can be given here as was given in Project 2 (Section 18.1). That is for a GSS system to be used continuously over a period of more than five years demonstrates that the client

group finds the GSS useful and attributes value to the GSS system, an argument that can find support in the comments of Eden (1992:215) and Martz et al (1992:154).

26.4 Evaluation of Similar Training Sessions in Denmark

The use of the system in a similar context (professional judgement training) has now been extended to Denmark, where a client assessment framework for elderly care services similar to Gerix has been developed. The framework should become standard across all municipalities by the end of 2003. The training programme for 'Common Language' has been developed by TeamStandards AS, and includes the use of the Teamworker GSS to support the training groups in a similar way to the methods used for Gerix training. The training group sizes are typically quite large, around 30 participants.

The participants in each of the training groups in Denmark are asked three evaluation questions at the end of each session, and a 9 point scale is used for the responses. The three evaluation questions and end points of the 9 point scale for each question are shown in Table 36.

| Evaluation Question | Scale Point 1 | Scale Point 9 |
|--|-------------------|-----------------|
| 1. To what extent has the training session given enough understanding to enable you to use 'Common Language' | Very little | Very much |
| 2. How do you rate the performance of the instructors? | Very bad | Very good |
| 3. How do you rate the effectiveness of using the Teamworker GSS in support of this training? | Very unsuccessful | Very successful |

Table 36: Evaluation Questions for 'Common Language' Training Sessions

Responses to these evaluation questions from the first 17 'Common Language' training sessions in Denmark have been made available through TeamStandards AS, and summary analyses are shown in Table 37.

| Evaluation Question Number | Percentage Responses | | | | | | | | |
|----------------------------|----------------------|-----|-----|-----|-----|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 0.0 | 0.7 | 0.9 | 2.3 | 8.9 | 14.3 | 30.9 | 19.7 | 22.3 |
| 2 | 0.0 | 0.0 | 0.3 | 0.2 | 3.8 | 5.6 | 19.5 | 37.1 | 33.5 |
| 3 | 0.2 | 0.0 | 0.0 | 0.3 | 1.7 | 1.3 | 5.8 | 23.3 | 67.4 |

Table 37: Responses to Evaluation Questions from First 17 'Common Language' Training Sessions

For the first evaluation question as detailed in Table 36, over 72% of participants gave a positive response of 7 or greater. For the second and third evaluation questions, over 90% of participants gave a response of 7 or greater. The 'Common Language' training programme team have been greatly encouraged by these results.

27 Discussion of Project Three

This project has involved an Action Research approach concerned with the initial trialling of the Teamworker GSS with groups being trained in the application of the Gerix method for the evaluation of clients requiring social care, and the subsequent adoption to support all training groups for professional judgement training in the application of the Gerix method for client evaluation, with the support of the Norwegian Government. Additionally, the use of the system in a similar context has now been extended to Denmark, where a client assessment framework for elderly care similar to the Gerix framework has been developed.

The process model adopted in the initial trials was found to encourage a discussion of differences of opinion, by displaying the initial assessments as a bar chart. The proposition was that, after discussion, participants would sometimes change their ratings of a variable as a result of learning more about the client, or about the appropriate use of the Gerix model of assessment from each other, and would improve their consistency of judgement.

The data collected has been explored in a variety of ways in order to evaluate the use of the Teamworker GSS from a number of perspectives. The results of the analyses undertaken lead to the following conclusions:

1. Changes of opinion frequently occur following the feedback of initial assessments coupled with discussion.
2. The dominant initial opinion (as identified by the initial modal value) has limited effect on these changes.
3. There is a greater degree of agreement among the participants (as measured by the range of assessment) following the feedback of the initial assessments and the ensuing discussion.
4. There appears to be rapid learning of the Gerix variables, in terms of how to place clients on the 1 to 4 scale in a consistent manner.
5. The participants in the initial trials appear to be very positive about the use of Teamworker as a support tool for professional judgement training in this context.
6. The Gerix Training Project Manager believed that the trials had been extremely successful, and demonstrated the benefit of using such a system in this particular training context.
7. Because of the perceived success of the trials, the Teamworker GSS has been adopted as a training support tool for generalised Gerix training, and has been used in this role for over five years (and is continuing to be used). Additionally, the Teamworker GSS has now also been adopted as a training support tool for group training in a similar framework in Denmark.
8. An analysis of seven training groups undergoing generalised Gerix training has shown that three Gerix variables require redefining to be less ambiguous, and that participants, if initially selecting an incorrect value for one of the other 14 Gerix variables, are likely to go towards the correct value following the feedback and discussion of the group scores.
9. Participants in these training groups appear to be very positive that the objectives of the training sessions have been achieved. Additionally, the participants in the 'Common Language' training sessions in Denmark appear to be very positive about the use of the Teamworker GSS to support professional judgement training.

I am not aware of any other application where a handset based GSS is used in this way to support professional judgement training in the use of a standardised framework (such

as 'Gerix' or 'Common Language'). Other research does, however, support the use of a GSS in a learning environment (e.g. Walsh et al, 1996; Irving and Hunt, 1994; Alavi, 1994; Khalifa and Kwok, 1999; Leidner and Fuller, 1997; Jones et al, 2001; Gear et al, 2003).

The evaluation of the application demonstrates that the design objectives of the application (to encourage dialogue and learning) appear to have been successful. These results support the proposition that group members are revising their assessments as a result of the dialogue that occurs when the feedback bar chart is shown to the group after initial scoring. The analyses in this project support the argument that that these revisions are based on clarification of the Gerix framework, rather than simply conforming to the dominant group position, and this proposition is supported by the comments made about the process by the Gerix project manager and Gerix training programme manager. Also, feedback from participants in terms of the effectiveness of the approach is encouraging, and the project managers charged with providing the training programme in both 'Gerix' and 'Common Language' are very positive of the benefits of using the Teamworker GSS in this context.

28 Annex 1 to Chapter 4 – Gerix Registration Document

| REGISTERKORT | | GERIX-START 1994 – 1995 | |
|---|--|---|--------------------------------------|
| Opplysningene er underlagt taushetsbestemmelser i forvaltningsloven | | | |
| ADMINISTRATIV INFORMASJON | | | |
| IDENTIFIKASJON | 1 Navn | | 2 Personnr. |
| | 3 Løpnr. | 4 Alder | 5 Kjønn |
| STATUS | 6 Ekteskapsstatus | | 1 Mann 2 Kvinne |
| | 7 Ugift | 2 Gift/samboer | 3 Separert/skilt |
| GEOGRAFISK INFORMASJON | 8 Dato siste forv. vedtak | | 9 Dato plantatt rev. av forv. vedtak |
| | 10 Komm. nr. | 11 Gate, navn og nr. | 12 Postnr. |
| | 13 Poststed | | 14 Bydel/distrikt |
| | 15 Sone | 16 Del av sone | 17 Grunnkrets |
| 18 Institusjonsnr. | | 19 Avdeling | |
| 20 Post | | | |
| BEHOVSDATA: Brukers tilstand | | | |
| | | Greier aktiviteten uten/med tilrettelegging | Avhengig av personhjelp |
| | | 1 2 | 3 4 |
| FUNKSJONSEVNE | 21 Innendørs mobilitet | | |
| | 22 Utendørs mobilitet | | |
| | 23 Personlig hygiene | | |
| | 24 Av-/påklædning | | |
| | 25 Toalett | | |
| | 26 Spising | | |
| | 27 Innkjøp | | |
| | 28 Matlaging | | |
| | 29 Rengjøring | | |
| | 30 Medisinsk egenomsorg | | |
| | 31 Orienteringsevne | | |
| | 32 Oppfatn. egen situasjon | | |
| | 33 Trygghet | | |
| | 34 Sosial kontaktevne | | |
| | 35 Initiativsevne | | |
| HELSE | 36 Ansvar egen hverdag | | |
| | 37 Kommunikasjonsevne | | |
| BEHOVSDATA: Brukers situasjon | | | |
| HUSST. & NETTVERK | 42 Bor alene Hvis sammen 43 Ektef. / 44 Barn 45 Foreld. 46 Søk. m. andre: 1 sam. 1 1 1 | | |
| | 47 Kontakt med nærmiljø (nettverk) | | |
| 1 Daglig 2 Regelmessig 3 Av og til 4 Aldri | | | |
| 48 Tilgang til privat/ikke offentlig hjelp | | | |
| 1 Ikke 2 Lite 3 Noe 4 Mye 5 Ukjent | | | |
| forts. neste kolonne: | | | |
| BEHOVSDATA: Brukers situasjon (forts.) | | | |
| BOLIGBOLIGTYPE | 49 Type strøk | | |
| | 1 Tett 2 Spredt | | |
| BOLIGBOLIGTYPE | 50 Type bolig | | |
| | 1 Vanlig bolig 2 - med tilrettelegte tjenester | 3 Aldersheim 4 Sykehjem | |
| BOLIGBOLIGTYPE | 51 Dagnopplysninger | | |
| | 1 Tjenester hele døgnet 2 Tjen. deler av døgnet | 3 Ja 4 Nei | |
| BOLIGBOLIGTYPE | 52 Kommunal bolig | | |
| | 1 Godt egnet 2 Egnet 3 Mindre godt egnet 4 Dårlig egnet | | |
| BOLIGBOLIGTYPE | 53 Innendørs husholdningsfunksjoner (mobilitet, matlaging, rengjøring) | | |
| | 1 Godt egnet 2 Egnet 3 Mindre godt egnet 4 Dårlig egnet | | |
| BOLIGBOLIGTYPE | 54 Personlige funksjoner (hygiene, toalett) | | |
| | 1 Godt egnet 2 Egnet 3 Mindre godt egnet 4 Dårlig egnet | | |
| BOLIGBOLIGTYPE | 55 Utendørs mobilitet | | |
| | 1 Godt egnet 2 Egnet 3 Mindre godt egnet 4 Dårlig egnet | | |
| BOLIGBOLIGTYPE | 56 Trygghet, trivsel, sosial kontaktmulighet | | |
| | 1 Godt egnet 2 Egnet 3 Mindre godt egnet 4 Dårlig egnet | | |
| BOLIGBOLIGTYPE | 57 Brukers vurdering | | |
| | 1 Foreligger 2 Foreligger ikke | | |
| BOLIGBOLIGTYPE | 58 Utvikling for brukeren siden forrige forvaltningsvedtak | | |
| | 1 Positiv 2 Uendret 3 Negativ | | |
| KOMMUNENS TJENESTER OVERFOR BRUKEREN | | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 59 Direkte hjelp pers. funksjoner | | 60 Direkte hjelp i huset |
| | 1 Timer, min. pr. uke | 1 Timer, min. pr. uke | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 61 Rehab./tren. pers. funksjoner | | 62 Rehab./tren. hush.funksj. |
| | 1 Timer, min. pr. uke | 1 Timer, min. pr. uke | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 63 Sykepleieprosedyrer | | 64 Psykososiale tiltak |
| | 1 Timer, min. pr. uke | 1 Timer, min. pr. uke | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 65 Tilsyn | | |
| | 1 Ikke tilsyn 2 Noe tilsyn 3 Mye tilsyn 4 Døgnbasis | 66 Hyppighet direkte persontil. og tilsyn: 1 Antall ganger pr. dag 2 - uke 3 - mnd. | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 67 Korporativt | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 68 Matombringing | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 69 Trygghetsalarm | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 70 Tekniske hjelpemidler | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 71 Boligtilpassing | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 72 Kultur-/fridstiltak | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 73 Utdanning | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 74 Arbeid | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 75 Støttekontakt | | |
| | 1 Fra kommunen 2 Fra andre 3 Ikke aktuelt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 76 Praktisering | | |
| | 1 Rammevedtak 2 Absolutt | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 77 Forventet utvikling hjelpebehov | | |
| | 1 Økning 2 Uendret 3 Redusert | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 78 Mengde tjenester | | |
| | 0 Intet 1 Lite 2 Noe 3 Mye 4 Svært mye | | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 79 Direkte hjelp | | 80 Rehabilitering |
| | 0 Ikke aktuelt 1 Aktuelt | 0 Ikke aktuelt 1 Aktuelt | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 81 Sykepleieprosedyrer | | 82 Psykososiale tiltak |
| | 0 Ikke aktuelt 1 Aktuelt | 0 Ikke aktuelt 1 Aktuelt | |
| DIR. PERS. TJENESTER YTT AV KOMMUNEN | 83 Andre tjenester | | |
| | 0 Ikke aktuelt 1 Aktuelt | | |
| OKONOMISKE FORHOLD | | | |
| YTELSE | 87 Tilskudd til reduksjon av boliggifter | | 88 Husleie-støtte |
| | 1 2 3 4 5 | 1 2 3 4 5 | |
| YTELSE | 89 Bostøtte/husbanken | | 90 Hj.støtte/tr.kontor |
| | 1 2 3 4 5 | 1 2 3 4 5 | |
| YTELSE | 91 Omsorgslønn | | 92 Andre ytelser |
| | 1 2 3 4 5 | 1 2 3 4 5 | |

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